FECAL COLIFORM TMDL FOR FOUR SEGMENTS IN THE CHOCTAWHATCHEE RIVER WATERSHED, FLORIDA

ALLIGATOR CREEK

BRUCE CREEK

CAMP BRANCH

FISH BRANCH

Final

USEPA Region 4
61 Forsyth Street
Atlanta, GA 30303

February 2001

TOTAL MAXIMUM DAILY LOAD (TMDL) SUMMARY

NOTE: THE FECAL COLIFORM TMDL FOR BRUCE CREEK REQUIRES *NO LOAD REDUCTIONS* OVER CURRENT CONDITIONS TO MEET WATER QUALITY STANDARDS

(FOR BRUCE CREEK ONLY, THE LOAD ALLOCATION (LA) IS EQUAL TO THE TOTAL EXISTING LOAD IN THE WATERSHED)

By definition: TMDL = WLAs + LAs + MOS

In terms of **concentration**:

Wasteload Allocation (WLA) = 0 fecal coliforms /100 ml
Load Allocation (LA) [+ Future Activities (Fut)]= 190 fecal coliforms /100 ml
Margin of Safety - explicit (MOS) = 10 fecal coliforms /100 ml

TMDL = WLA + LA + MOS + Fut = **200 fecal coliforms /100 ml**

In terms of **load**:

Alligator Creek -- Map ID 26
Wasteload Allocation (WLA) = 2.45E+11 fecal coliforms /day
Load Allocation (LA) = 6.95E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 3.67 E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities= 0 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **7.34 E+13 fecal coliforms/30 days**

Bruce Creek -- Map ID 11
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 1.87E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 1.24E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities= 4.98E+12 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **2.48 E+13 fecal coliforms/30 days**

Camp Branch Map -- ID 21
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 7.28E+12 fecal coliforms/30 days
Margin of Safety (MOS) = 3.83E+11 fecal coliforms/30 days
Reserve for Future Growth/Activities= 0 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **7.66E+12 fecal coliforms/30 days**

Fish Branch -- Map ID 28
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 2.43E+12 fecal coliforms/30 days
Margin of Safety (MOS) = 1.28E+11 fecal coliforms/30 days
Reserve for Future Growth/Activities = 0 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **2.55E+12 fecal coliforms/30 days**

Contents

TABLES

FIGURES

1.0 INTRODUCTION

COMPANION REPORT

This is one of two TMDL reports prepared at this time for the Choctawhatchee River watershed in Florida. The companion report is titled, “Fecal Coliform TMDL for Three Segments in the Choctawhatchee River Watershed, Florida – Choctawhatchee River (2), Sikes Creek.”

1.1 PURPOSE

Levels of coliform bacteria can become elevated in waterbodies as a result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA’s Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting designated uses even though sources have implemented technology-based controls. A TMDL establishes the allowable load of a pollutant or other quantifiable parameter based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991). The process of developing a TMDL requires

- identification of a water quality problem;
- identification of a water quality goal or endpoint;
- review and analysis of available data;
- identification and characterization of sources of the pollutant causing the water quality problem;
- allocation of pollutant loads (i.e., establishment of a plan to correct the problem by controlling sources); and
- establishment of a monitoring plan to assess the effectiveness of the TMDL and its pollutant controls.

The headwaters of the 5,362-square mile (mi^2) Choctawhatchee River watershed are in southern Alabama, while the remainder of the watershed lies within the panhandle of northwest Florida (Figure 1-1). The river and its tributaries traverse five counties in Florida (Bay, Holmes, Jackson, Walton, and Washington) and nine in Alabama (Pike, Barbour, Coffee, Dale, Geneva, Houston, Henry, Covington, and Bullock). It is the fourth largest river in Florida in terms of flow and drainage area. The Choctawhatchee River is designated for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Class III). The Choctawhatchee River is also afforded special protection under Chapter 62-302.700 because it is designated as a Special Water.

The Choctawhatchee River system has historically supported a rich and diverse ecology and is a proven substantial economic, recreational, and aesthetic resource for northwest Florida residents and visitors. For many years, however, the system has been used as a “sink” for nonpoint source pollution and wastewater treatment plant effluent (NWFWMD, 1996). The objective of this study is to develop TMDLs for segments of the Choctawhatchee River system that have been identified on Florida’s 303(d) list as impaired because of exceedances of Florida’s water quality standard for fecal coliform bacteria.

Four segments of the Choctawhatchee River and its tributaries have been placed on Florida’s 1998 303(d) list as fecal coliform-impaired waterbodies by the Florida Department of Environmental Protection (FDEP). This impairment has resulted in non-attainment of designated uses, including recreation, for Bruce Creek, Camp Branch, Alligator Creek, and Fish Branch. The objective of this study is to develop TMDLs for fecal coliform for Bruce Creek, Camp Branch, Alligator Creek, and Fish Branch in the Choctawhatchee River watershed.

Section 2 characterizes the study area, describes the designated uses associated with the resource, and identifies physical and land use characteristics. Section 3 inventories and evaluates relevant water quality data for the Choctawhatchee River watershed.. Section 4 identifies and characterizes the sources of fecal coliform with the Choctawhatchee River watershed.. Section 5 presents the modeling and analysis methodologies used to link source loading and water quality response. Section 6 presents the elements of the TMDLs for the four listed segments in the Choctawhatchee River watershed.

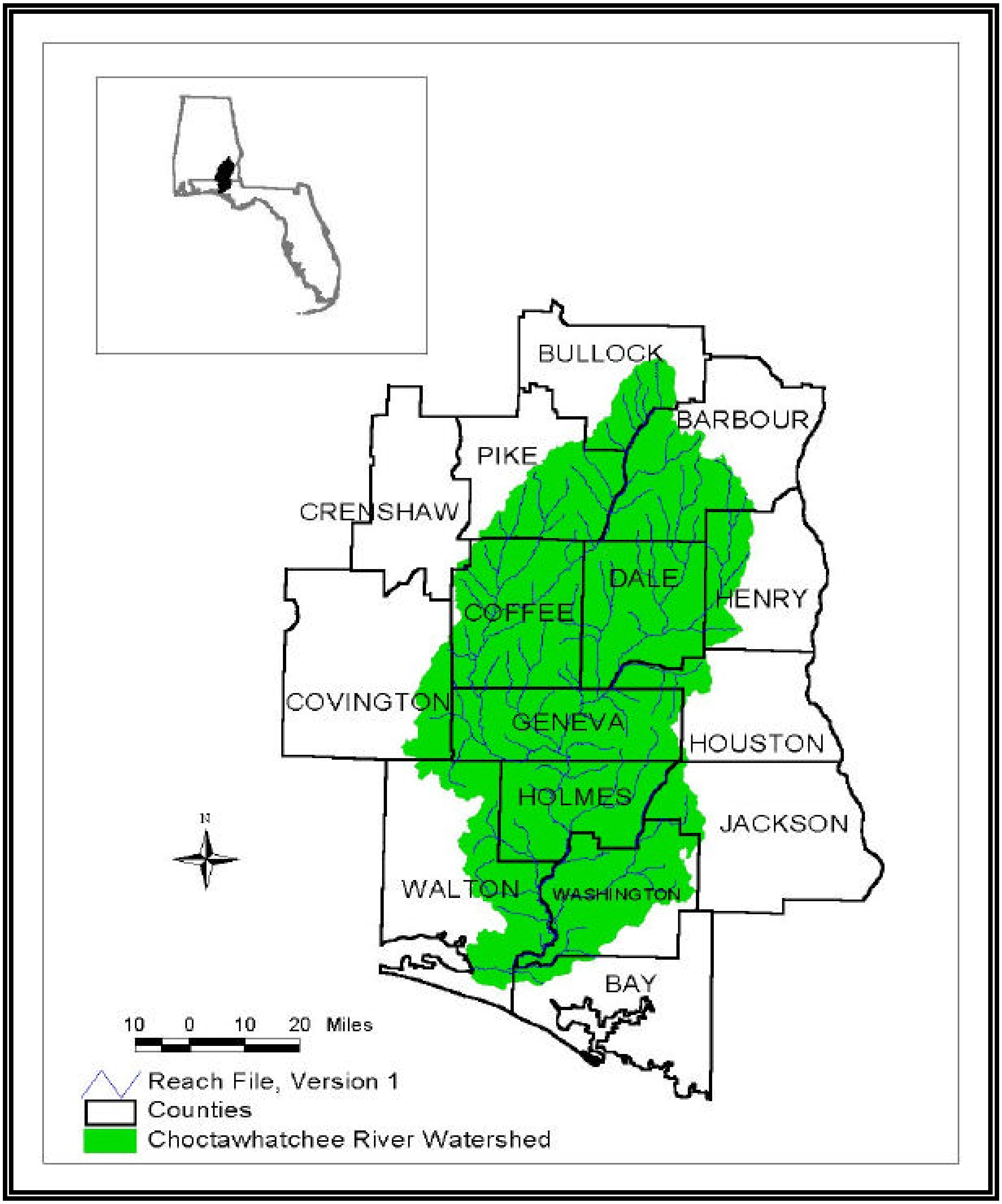


Figure 1-1. Location of the Choctawhatchee River Watershed

2.0 PHYSICAL CHARACTERISTICS

The purpose of this section is to characterize the Choctawhatchee River watershed by identifying existing land uses, soils, topography, ecology, and land and resource management activities; and describing the water quality standards associated with this resource.

2.1 STUDY AREA

The Choctawhatchee River drainage is approximately 5,362 mi^2. Approximately 41 percent (2,193 mi^2) of this total area is located in Florida (NWFWMD, 1996). The Choctawhatchee River originates in southern Alabama, and flows about 89 miles from the Florida-Alabama line to Choctawhatchee Bay (Hand, Col, and Lord, 1996). It is the fourth largest river in Florida in terms of flow and drainage area, with an average annual discharge of 7,198 cubic feet per second (cfs). Principal tributaries include the Pea River in Alabama and Holmes, Wrights, Sandy, Pine Log, Seven Run, and Bruce creeks in Florida. The Choctawhatchee River's surface water flow is formed by these major tributaries, as well as groundwater contributions from springs and the Floridan Aquifer (FDEP, 1998).

Because the 303(d) listed segments are contained within the Florida portion of the Choctawhatchee River watershed, this characterization focuses on the Lower Choctawhatchee River cataloging unit (CU 03140203). The Lower Choctawhatchee River cataloging unit contains the portion of the watershed in Florida and a fraction of the portion in Alabama. The Lower Choctawhatchee River cataloging unit is approximately 1,552 mi^2 with 1,420 mi^2 in Florida, as shown in Figure 2-1.

Choctawhatchee River System: Vital Statistics

- *The Choctawhatchee River watershed covers approximately 5,362 mi^2 in Alabama and Florida.*
- *The watershed covers portions of five Florida counties: Holmes, Washington, Jackson, Bay, and Walton.*
- *The Choctawhatchee is Florida's fourth largest river in flow and drainage area. Its average annual discharge is 7,198 cfs.*
- *There have been 13 major floods of the Choctawhatchee River this century. Two occurred in the 1990s.*
- *The watershed is growing rapidly. The human population in the Florida counties increased 41 percent from 1980 to 1995.*
- *The Choctawhatchee River system provides substantial economic and quality of life benefits. Activities supported by the system include fishing, boating, water sports, hunting, camping, and commercial barge shipping. The quality of the system is important for aesthetics, property values, tourism, and public health.*

Source: Adapted from NWFWMD, 1996.

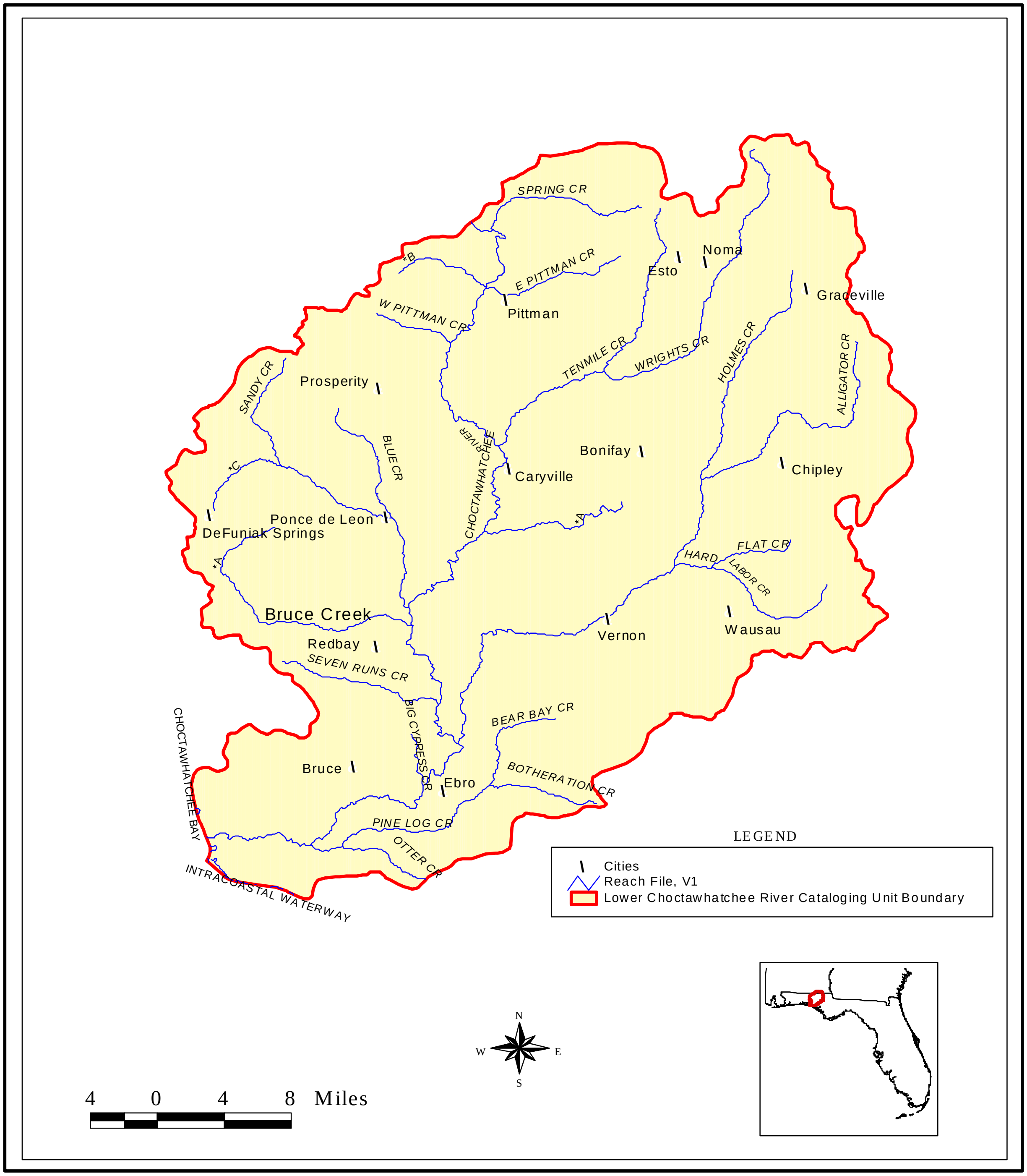


Figure 2-1. The lower Choctawhatchee River cataloging unit

The upper Choctawhatchee flows through steep banks and creates large sandbars, while the lower river flattens into a swampy floodplain up to a mile wide. The river is generally characterized as alluvial and tends to carry high sediment loads. In fact, the Choctawhatchee is regarded the “muddiest” of Florida rivers (Nordlie, 1990). It flows through limestone, and springs contribute considerable amounts of fresh water to the system. Several acidic blackwater creeks also drain into the river and its major tributaries. The basin has all three major river types (i.e., alluvial, spring-fed, and blackwater) as well as several lakes (Hand, Col, and Lord, 1996).

Agriculture and silviculture are the major land uses in the basin. The Nature Conservancy; the Northwest Florida Water Management District (NWFWMD); and the Florida Division of Forestry, part of the Department of Agriculture and Consumer Services, own much of the actual river corridor, and approximately 87 percent of the Choctawhatchee River basin is forested (EPA, 1998). Numerous public and private recreation areas and facilities are directly or indirectly associated with the Choctawhatchee River. Tourism continues to be a strong component of the area’s economy. Fishing, hunting, scuba diving, hiking, and canoeing have long been mainstays of the region’s tourist economy (NWFWMD, 1996). While resident population densities are relatively low, the area is growing quickly.

2.1.1. 303(d)-Listed Segments

The State of Florida identified 15 impaired waterbodies in the Choctawhatchee River watershed on its 1998 303(d) list. The four segments addressed in this study are impaired by fecal coliform bacteria (see Figure 2.2). The following paragraphs briefly summarize FDEP descriptions of the 303(d)-listed coliform-impaired segments (FDEP, 1998).

Bruce Creek. Bruce Creek is located in eastern Walton County with headwaters in the south and southeastern areas of DeFuniak Springs. The Bruce Creek watershed drains land with uses classified as agriculture; silviculture; commerce; residences; industry; and urban, impoundment, road/highways, dirt road, and electrical transmission areas. FDEP has identified runoff from chicken growers, wastewater/sludge land application, and livestock as sources of bacteria.

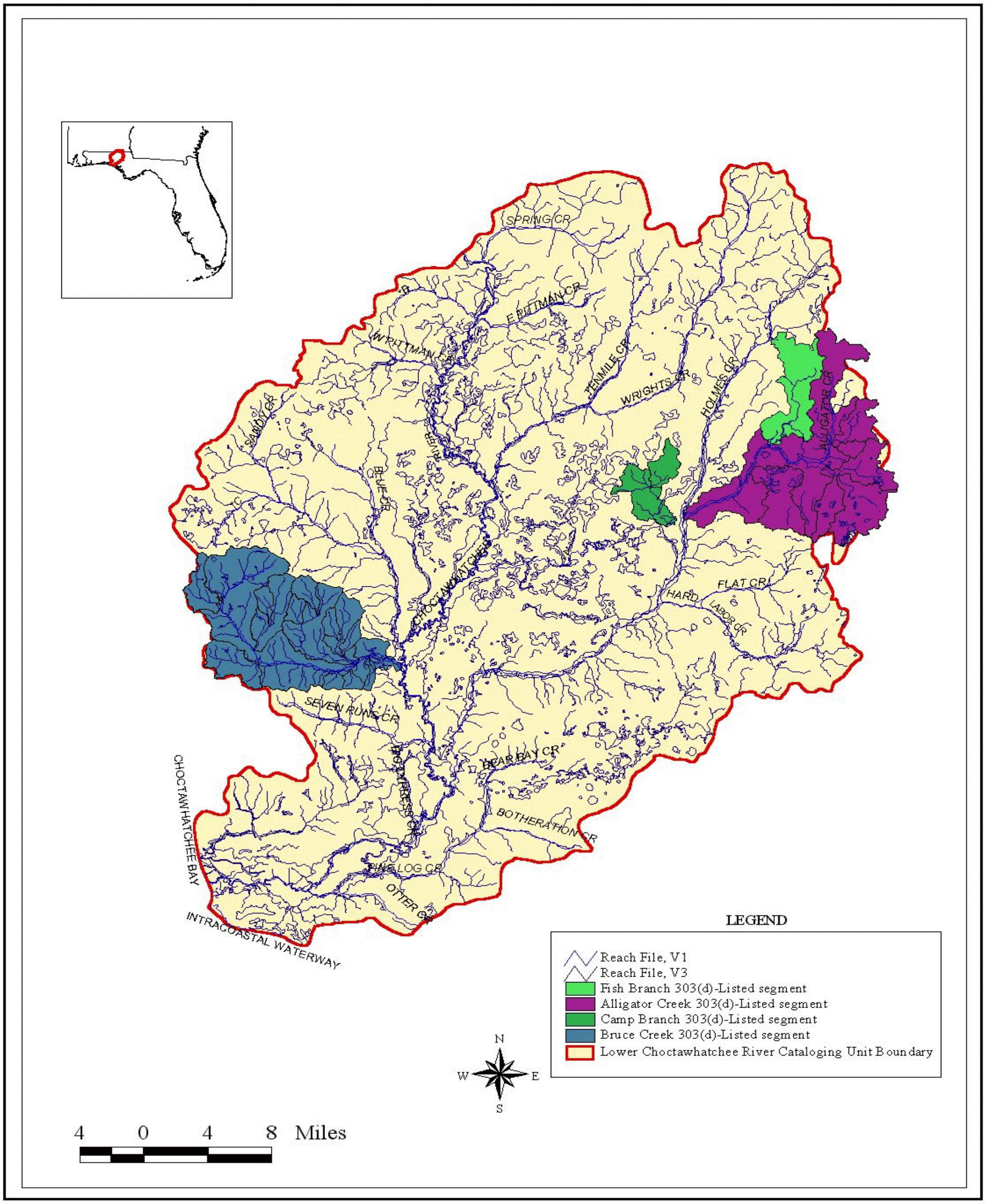


Figure 2-2. 303(d)-listed segments within the Choctawhatchee River watershed

Camp Branch. The Camp Branch basin extends south of Bonifay past Interstate 10 to the Choctawhatchee River via Holmes Creek. Land uses include agriculture, silviculture, residences, commerce, industry, and urban, road/highway, dirt road, impoundment, electrical transmission, recreational, and sewage treatment areas. Potential coliform sources include dairy/livestock runoff, sewage line leaks, and STP upsets. Upper Camp Branch receives runoff from dairy farms.

Alligator Creek. The headwaters of Alligator Creek are in Jackson County, south of Graceville and Campbellton. Alligator Creek is a tributary to Holmes Creek. Land use in the watershed includes agriculture, silviculture, residences, commerce, industry, and urban, strip mine, solid waste disposal, impoundment, electrical transmission, and road/highway areas. The Chipley STP discharges to Alligator Creek near its mouth, impacting coliform levels, as well as concentrations of dissolved oxygen, biological oxygen demand, and nutrients.

Fish Branch. Fish Branch discharges to Holmes Creek in northwest Jackson County just south of Graceville. Land use in the basin is predominately agriculture, silviculture, commerce, residences, electrical transmission, impoundment, road/highways, and dirt road areas. Bacteria sources may include livestock runoff (FDEP, 1998).

2.1.2. Topography, Geology and Soils

The geology of the Florida panhandle contains uneven platforms of limestone and dolomite rock, covered by thick deposits of organics and clastics (i.e., silt, clay, shell, gravel, and marl) (FDEP, 1998). More specifically, the Choctawhatchee River system bisects the Western Highlands, Marianna Lowlands, New Hope ridge, and Coastal Lowlands physiographic regions.

Topography in the watershed ranges from nearly level to sloping. Frequently, soils are well-drained and sandy in the uplands, and often underlain by loam or clay. Soils in the lowland floodplain may be poorly drained and hydric. Erosion is substantial in portions of the watershed, and the river system discharges a considerable amount of sediment into Choctawhatchee Bay.

Soils within the middle reaches (Holmes County) of the Choctawhatchee River are of the Dothan-Orangeburg-Fuquay association, which is characterized by gentle slopes and thick sandy or loamy layers. Soils in the lower reaches vary from gently sloping and sandy further from the river, to nearly level and loamy and poorly-drained within the floodplain. Poorly-drained soils near streams are often exposed and eroded clay subsoils (NWFWMD, 1996).

Elevations in the Choctawhatchee River basin range from 0 to 358 feet, with a mean elevation of 139 feet.

2.1.3. Climate

Northwest Florida has a mild, subtropical climate. Average annual temperatures tend to be in the upper 60s (degrees Fahrenheit), with mean summer temperatures reaching the low 80s and mean winter temperatures dropping to the low 50s (NWFWMD, 1996).

Prevailing winds are southerly during the spring and summer, and northerly during the fall and winter. Average annual rainfall in northwest Florida is approximately 60 inches (NWFWMD, 1996). Average annual rainfall in the Florida panhandle is 38 inches. There are two peak periods: one from June through August and a second from February through April (FDEP, 1998). Peak rainfall is typically measured in the summer, particularly July. October tends to be the driest month during most years. Table 2-1 summarizes the average monthly and annual rainfall data for the Choctawhatchee area.

Tropical storms and hurricanes can significantly impact the hydrology of northwest Florida. Several storms have made landfall over the Choctawhatchee River watershed during the 1990s. In 1994, for example, tropical storm Alberto dropped over 13 inches of rain in the Choctawhatchee River basin, resulting in the greatest floods on record since 1929 (NWFWMD, 1996).

Table 2-1. Average rainfall at Eden State Gardens near Chocotawhatchee Bay (FDEP, 1998)

Month	1992	1993	1994	Mean
January	5.31	5.35	4.87	5.18
February	10.47	6.88	3.43	6.93
March	2.27	6.24	7.44	5.32
April	1.37	2.52	3.87	2.59
May	1.57	0.82	0.99	1.13
June	5.33	6.86	7.62	6.60
July	8.54	1.25	16.72	8.84
August	13.93	3.17	2.26	6.45
September	3.28	6.01	4.75	4.68
October	1.66	3.40	8.06	4.37
November	9.46	3.08	2.59	5.04
December	3.40	4.90	2.76	3.69
Year Total	**66.59**	**50.48**	**65.36**	**60.62**

2.1.4. Land Use

The major land covers and uses in the Choctawhatchee watershed include forest/silviculture and agriculture. Urban land is estimated to comprise approximately two percent of the watershed in Florida (NWFWMD, 1996). Farming, forestry, and fisheries are more important in the predominantly rural counties of Holmes, Walton, and Washington.

Table A-1 in Appendix A presents a complete list of the Florida land use categories for the year 1995 with the associated TMDL categories.

Table 2-2 summarizes the land use distribution in the watershed of each of the seven 303(d)-listed segments, using the TMDL categories. Table A-2 in Appendix A contains a complete list of the Florida land uses and their associated acreage.

Table 2-2. Land uses in the watersheds of 303(d)-listed segments of the Choctawhatchee River watershed

Land Use	Alligator Creek (acres)	Bruce Creek (acres)	Camp Branch (acres)	Fish Branch (acres)
Cropland[a]	15,440.16	2,658.43	1,276.77	812.97
Forest/Vegetated	18,389.98	41,523.22	5,062.49	656.08
Open Land	83.24	36.44	0.00	4.41
Other	48.78	195.08	0.00	0.00
Pasture[a]	8,471.80	2,098.27	939.09	351.82
Residential	2,544.94	2,014.90	589.99	124.73
Urban	570.25	1,235.33	576.37	25.76
Wetlands	6,543.51	4,007.47	1,341.02	227.20
TOTAL	52,092.66	53,769.15	9,785.73	2,202.97

[a]Florida land use classification is "Cropland and Pasture." To separate into "Cropland" and "Pasture," the ratio of cropland and pasture from the 1997 Census of Agriculture for the appropriate counties was applied to the Florida classification.

2.1.5. Hydrology and Channel Morphology

Data in Table 2-3 characterize the channel geometry and flow for 303(d)-listed segments in the Choctawhatchee River watershed. Data for Alligator Creek and Bruce Creek come from Reach File, Version 1 (RF1). Data for Camp Branch comes from Reach File, Version 3 (RF3). Reach File 3 database provides limited data on stream characteristics and the coverage in the area makes it difficult to identify or measure the lengths of these two streams. It should be noted that Table 2-4 presents general information for characterization of the entire listed segment. For the analysis, the listed segments and their tributaries were appropriately broken into smaller reaches. Identification of stream measurements for the different reaches comprising the stream network of the listed segments is discussed in Section 5.3.2 (Model Setup).

Table 2-3. Reach File 1 channel geometry and flow information for the two segments in the Choctawhatchee River watershed identified on Florida's 303(d) list as impaired for bacteria

Listed segment	Length (mile)	Mean Flow (ft^3/s)	7Q10 (ft^3/s)	Slope	Mean Depth (ft)	Mean Width (ft)
Alligator Creek	19.3	181.84	60.61	0.00084	1.24	49.98
Bruce Creek	20.6	154.37	51.46	0.00154	1.07	40.31

2.2 RESOURCE MANAGEMENT ACTIVITIES AND ISSUES

The entire Choctawhatchee River watershed is within two states. It includes portions of 15 counties (six in Florida, 9 in Alabama) and 24 incorporated communities. Management of the system includes the activities of numerous local governments, state and federal agencies, non-government organizations, and the private sector (NWFWMD, 1996).

Local governments and agencies in Florida that have jurisdiction within the Choctawhatchee watershed include Walton County, covering approximately 44 percent of the watershed area within Florida; Washington and Holmes counties, each covering 25 percent of the watershed; and Jackson and Bay counties, covering 4 percent and 2 percent of the watershed, respectively.

Incorporated cities within the Florida portion of the Choctawhatchee watershed include: Bonifay, Esto, Noma, Ponce de Leon, and Westville (Holmes County); Chipley, Caryville, Vernon, Ebro, and Wausau (Washington County); Freeport and DeFuniak Springs (Walton County); and Graceville (Jackson County). Incorporated communities within Bay County occur along the Choctawhatchee Bay and are not within the watershed of the river.

The portion of the watershed in Alabama (approximately 3,112 mi^2) includes 9 counties: Bullock, Pike, Barbour, Dale, Coffee, Covington, Geneva, Henry, and Houston. Incorporated cities include Dothan, Ozark, and Enterprise.

2.2.1. Chapter 62, Florida Administrative Code

Water Quality Standards

Florida's surface water quality standards, as established in Chapter 62-302 of the Florida Administrative Code, vary according to a waterbody's surface water classification. The Choctawhatchee River is a Class III freshwater waterbody designated for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Waterbody classifications are arranged according to the degree of protection required: Class I waters generally have the most stringent water quality criteria and Class V waters generally have the least stringent criteria. Criteria applicable to a classification are designed to maintain the minimum conditions needed to ensure the suitability of water for the designated use of the waterbody.

The Florida state standard for bacteriological quality for fecal coliform bacteria specifies the following:

> The number per 100 mL (Most Probable Number (MPN) or membrane filter (MF)) counts) shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period (Chapter 62-302.530 F.A.C.).

Outstanding Florida Waters Designation

Chapter 62-302.700 of the Florida Administrative Code (F.A.C.) affords special protection to waterbodies designated by the state of Florida as Outstanding Florida Waters (OFW) or Outstanding National Resource Waters (ONRW). Under this designation no degradation of water quality, other than that allowed in Rule 62-4.242(2) and (3), F.A.C., is permitted. The Choctawhatchee River is afforded special protection under Chapter 62-302.700 because of its designation as a Special Water by FDEP.

2.2.2. State Resource Management Agencies

Florida Department of Environmental Protection

The FDEP is Florida's principal environmental and natural resources management agency. It is responsible for regulating air, water, wastewater, storm water, and hazardous waste pollution through a permitting and certification process. FDEP implements the OFW program, enforces water quality standards, and administers aquatic preserves. Its mission is to protect, conserve, and manage Florida's environment and natural resources. FDEP accomplishes its mission in a manner that

- Provides stewardship of Florida's ecosystems so that the state's unique quality of life may be preserved for present and future generations.

- Protects the public health and safety.

- Provides for the responsible and wise use of the state's mineral, cultural and living resources.

- Provides efficient and equitable service to the public.

- Provides consistent and impartial implementation of the law.

FDEP's Northwest District office, located in Pensacola, facilitates management of the Choctawhatchee River and Bay system.

In 1993, the FDEP initiated a process to develop an ecosystem management strategy for the state, resulting in the *Ecosystem Management Implementation Strategy* (EMIS) published in October 1995. The EMIS document set forth fundamental site-specific strategies, which required identifying major watershed basins called Ecosystem Management Areas (EMAs). The Choctawhatchee EMA is one of six designated by the FDEP Northwest District. EMAs are delineated by watershed. The boundaries of the Choctawhatchee EMA are consistent with the Choctawhatchee River Surface Water Improvement and Management (SWIM) planning area with comparable objectives towards watershed management.

Northwest Florida Water Management District

Since its establishment in 1972, the Northwest Florida Water Management District (NWFWMD) has been involved in efforts to understand and appropriately manage the Choctawhatchee River (NWFWMD, 1996). Research and management efforts have included studies of sedimentation, fish populations, thermal anomalies, and submerged vegetation. The NWFWMD has acquired over 51,189 acres along the Choctawhatchee River and its tributaries through the Save Our Rivers and Preservation 2000 programs. This equates to approximately 87 percent of Florida's portion of the floodplain. These lands are managed to facilitate the conservation and restoration of their natural, aesthetic, hydrologic, and recreational values (NWFWMD, 1996). Their public status precludes intensive development.

Choctawhatchee River and Bay Surface Water Improvement and Management (SWIM) Plan. In Chapter 373, Florida Statutes, the Florida Legislature determined that the water quality in many of the state's waterbodies is either degraded or in danger of degradation. Where associated systems have suffered as a result of degraded water quality, so have aesthetics, recreation, wildlife habitat, drinking water, and associated economic resources. Causes of degradation include point and nonpoint source pollution and destruction of natural systems that enhance water quality and provide habitat. In response to the identified problems, the Florida Legislature directed the state's five water management districts to develop and implement plans to improve water quality and related aspects of the State's surface waters. SWIM plans describe the physical and biological character of an identified basin, issues surrounding management of the basin, and projects designed to address identified issues (NWFWMD, 1996).

After identifying the Choctawhatchee system as a SWIM priority waterbody, in December 1996, the NWFWMD completed a plan for its protection and restoration. The plan is intended to:

- characterize the Choctawhatchee River and Bay system;
- describe ongoing resource management activities;
- identify major problems affecting the system; and
- propose a strategy and set of projects that, if implemented, will facilitate the long-term restoration and protection of the system.

Save Our Rivers program. Section 373.59 Florida Statutes created funds that allow water management districts to acquire lands for water management, water supply, and conservation or protection of water resources.

Florida Department of Agriculture and Consumer Services

The Florida Department of Agriculture and Consumer Services (DACS) is responsible for regulating the purchase and use of restricted pesticides and assists the Natural Resources Conservation Service (NRCS) with soil and water conservation. The DACS Division of Forestry administers approximately 355 acres of bottomland forest along Holmes Creek and the Choctawhatchee River (Choctawhatchee River State Forest).

Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FWCC) has regulatory and management jurisdiction over game and nongame wildlife and freshwater aquatic life throughout the Choctawhatchee River watershed (NWFWMD, 1996).

Alabama State Agencies

Alabama agencies that are responsible for managing the Choctawhatchee River watershed include the Alabama Department of Environmental Management (DEM), the Department of Conservation and Natural Resources, the Game and Fish Division of the Department of Conservation and Natural Resources, and the Choctawhatchee and Pea Rivers Watershed Management Authority.

2.2.3 Federal Resource Management Agencies

Federal laws relevant to the Choctawhatchee basin include the National Flood Insurance Act of 1968, the Clean Water Act of 1977 (amended 1987), the National Environmental Policy Act of 1969, and Endangered Species Act of 1973, as amended. Federal agencies responsible for implementing these laws include the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), U.S. Air Force, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency (USEPA).

Approximately 242,243 acres (378 mi^2) of the Choctawhatchee watershed are within the Eglin Air Force Base Reservation. At 464,000 acres, this base is one of the world's largest military installations (NWFWMD, 1996).

3.0. INVENTORY OF WATERSHED INFORMATION

This section presents an overview of the instream water quality monitoring data and flow data available for waterbodies in the Choctawhatchee River watershed. The purpose is to inventory available data that are appropriate to use in characterizing the problem and developing fecal coliform TMDLs for the four impaired segments. The water quality data related to fecal coliform bacteria for the Choctawhatchee River watershed and presented in this section were collected from USEPA's STORET database.

3.1 EXISTING MONITORING AND FIELD ASSESSMENT DATA

3.1.1 Water Quality Data

Choctawhatchee River Watershed in Florida

A number of state and federal agencies monitor water quality within the Choctawhatchee River watershed in Florida. The FDEP, FDEP Northwest District office, the NWFWMD, USGS, U.S. Fish and Wildlife Survey (USFWS), and the USEPA are currently monitoring for fecal coliform.

The *Northwest Florida District Water Quality Assessment, 1996 305(b) Technical Appendix* describes the overall water quality in the Choctawhatchee River as good. Although, some of the tributaries received water quality ratings of fair to poor. The worst water quality detected by the NWFWMD was at the Alabama-Florida border during water quality sampling conducted in the mid-to-late 1980s–about ten years ago. In 1989, 27 permitted domestic waste facilities and 10 permitted industrial facilities discharged into the river system in Alabama (NWFWMD, 1996). The published 305(b) Report for 2000 does not include significant updates. Based on EPA's PCS database, there are currently 8 active domestic and/or industrial wastewater facilities in the Florida portion of the Choctawhatchee River watershed.

A comprehensive search for the Choctawhatchee River watershed in Florida was conducted in the STORET database, which includes data from USGS, EPA Region IV, FDEP, U.S. Forest Service, and NWFWMD databases. There are 88 existing or past monitoring stations within the Choctawhatchee River watershed in Florida that have at least one observation of fecal reported in STORET. Only data from stations with a minimum of five data points for fecal coliform since 1980 were used to evaluate water quality conditions. Using this criterion, data from 36 of the 88 monitoring stations were used to assess current water quality conditions. Six of the 36 stations are located on 303(d)-listed segments. The 6 monitoring stations are displayed in Figure 3-1.

3.1.2 Flow Data

Choctawhatchee River Watershed in Florida

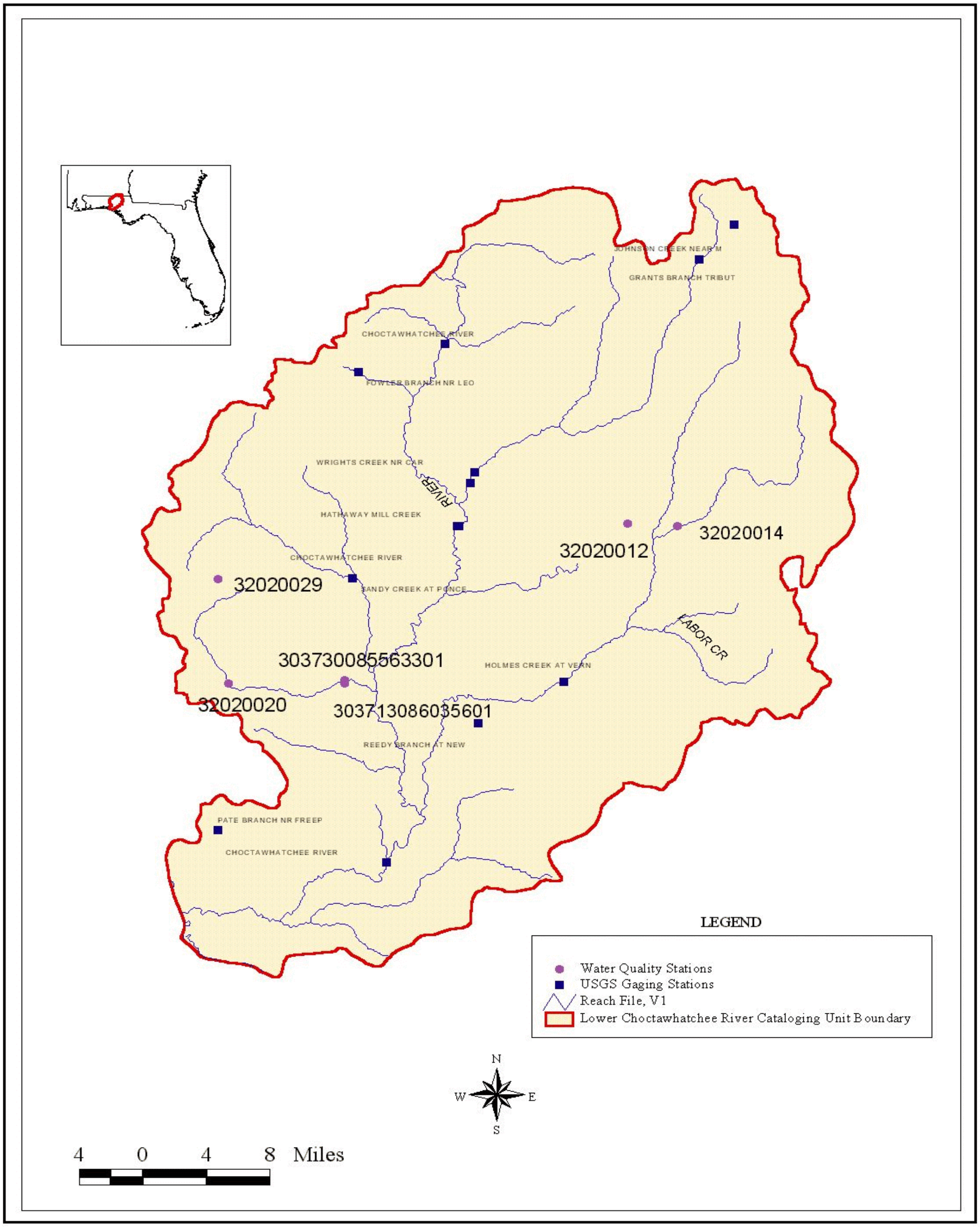
There are 11 USGS flow gaging stations within the Lower Choctawhatchee cataloging unit in Florida. Table 3-1 inventories these gages. Also listed in the table is the period of record of available continuous daily flow data.

No flow data were collected concurrent with most of the fecal coliform data that were collected throughout the subwatersheds of the Choctawhatchee River in Florida.

Table 3-1. USGS flow gages within the Lower Choctawhatchee River watershed in Florida

Station No.	Station Name	County	Period of Record[a]
02365200[b]	Choctawhatchee River near Pittman, FL	Holmes	7/1/76-9/30/81
02365237	Fowler Branch near Leonia, FL	Holmes	n/a[c]
02365435	Wrights Creek near Bonifay, FL	Holmes	n/a[c]
02365470	Wrights Creek at 177-A near Bonifay, FL	Holmes	n/a[c]
02365500[b]	Choctawhatchee River at Caryville, FL	Holmes	10/1/29-3/31/95; 10/1/96-9/30/97
02365700	Sandy Creek at Ponce De Leon, FL	Holmes	n/a[c]
02366000	Holmes Creek at Vernon, FL	Washington	n/a[c]
02366164	Reedy Branch at New Hope, FL	Washington	n/a[c]
02366500	Choctawhatchee River near Bruce, FL	Walton	10/1/30-3/31/83; 6/1/84-9/30/97
02366859	Pate Branch near Freeport, FL	Walton	n/a[c]
02365310	Grants Branch Tributary near Fadette, AL	Geneva	n/a[c]

[a] Period of record for daily flow data. Does not include peak flow data.
[b] Listed on 303(d)-listed segment
[c] Only peak flow data is available for this station.
Shaded rows indicate gage stations where water quality data are also collected.



Figures 3-1. Water quality monitoring stations with at least 5 fecal coliform data points from 1980 to 1998 on the listed segments and USGS gage stations within the Choctawhatchee River watershed

3.2 ASSESSMENT OF WATER QUALITY CONDITIONS

Six of the 88 water quality monitoring stations within the Choctawhatchee watershed in Florida are located on listed segments and had a minimum of five data points for fecal coliform since 1980. Those stations are located on four of the seven segments identified as impaired on Florida's 1998 303(d) list–Bruce Creek, Camp Branch Creek, and Alligator Creek. The preceding Table 3-1 summarized the water quality data collected at these six stations, which are indicated by shaded rows. Table 3-2, following, shows the minimum, median, and maximum values of fecal coliform counts, as well as the number of violations of the applicable water quality criteria (i.e., instantaneous maximum of 800 cfu/100 mL for fecal coliform.

Monitoring stations in Alabama that are closest to the state line include the following: Pea River, Double Bridges Creek, Sandy Branch, Claybank Creek. and Hurricane Creek. Fecal coliform was measured at each of these stations; however, not one violation of water quality standard were indicated. Data indicate that other stream segments further north in the watershed may have bacteria problems. Blanket Creek had two violations in four samples, using Florida's standard as the threshold, with a maximum concentration of 2,500/100 mL and a median concentration of 766/100 mL. The Unnamed Tributary to Harrand Creek had 3 violations in four samples with a maximum concentration of 15,000/100 mL, a median concentration os 4,000/100 mL, and a minimum concentration of 688/100 mL Walnut Creek had one violation in five samples, with a maximum concentration of 1,040/100 mL and a median concentration of 57/100 mL. The actual data used for the evaluation of water quality conditions in the Choctawhatchee River watershed are presented in Appendix B.

Table 3-2. Summary of available water quality data in the Choctawhatchee watershed at monitoring stations with at least five samples collected from 1980 to 1998

Station	Location	Start Date	End Date	No. of Samples	Min	Median	Max	Violations of WQS	Percent Violating [a]
32020029	Bruce Cr N Arm	2/16/82	9/5/90	6	170	1,350	3,900	3	50
32020020	Bruce Cr Hwy 81 N Of Red Bay	12/2/90	5/13/97	22	10	80	1,900	2	9
32020012	Camp Branch At Hwy 90	8/15/93	5/13/97	16	20	135	1,200	1	6
32020014	Alligator Cr Hwy 90 West Of Chipley	5/24/84	5/13/97	18	10	95	40,000	3	17
303713086035601	Bruce Creek below Panther Cr.	12/15/92	8/18/93	5	1	94	172	0	0
303730085563301	Bruce Creek @ C.R. 81	12/9/92	10/16/95	8	24	46	110	0	0

[a] Number of instances violating the instantaneous standard of 800/100 mL on any given day. (Sufficient data were not available to compare to the geometric mean standard of 200/100 mL.)

4.0 SOURCE ASSESSMENT

Sources of fecal coliform bacteria are numerous and often occur in combination. Potential point sources include poorly treated municipal sewage, urban stormwater runoff, sanitary sewer overflows, combined sewer overflows (CSOs), and untreated domestic sewage. Potential nonpoint sources include manure disposal and runoff of animal waste from feedlots, disposal and handling of poultry litter, failing or ill-sited septic systems, runoff from pasture lands, application of manure or municipal sludge to cropland and other agricultural areas, and loadings from various wildlife species.

4.1 Assessment of Point Sources

The greatest potential source of human fecal coliform from point sources is raw sewage. Raw sewage typically has a fecal coliform count of 10^6 to 10^8/100mL (Metcalf & Eddy, 1991), along with significant concentrations of viruses, protozoans, and other parasites. Raw sewage, while usually not discharged intentionally, may reach waterbodies through leaks in sanitary sewer systems, overflows from surcharged sanitary sewers (non-combined sewer), illicit connections of sanitary sewers to storm sewer collection systems, or unidentified broken sanitary sewer lines.

USEPA's permit compliance system (PCS) files and other sources were queried to identify and characterize any point sources discharging fecal coliform bacteria within the watersheds of listed segments in the Florida portion of the Choctawhatchee River basin. The facility listed in Table 4-1 discharges fecal coliform bacteria directly into a 303(d)-listed segment or its tributaries (NWFWMD, 1996; Permit Compliance System (PCS), 1998). Table 4-1 summarizes the characteristics of this discharge.

Table 4-1. Permit characteristics of NPDES dischargers within watersheds of 303(d)-listed segments in the Choctawhatchee River (as reported in PCS)

Facility	NPDES No.	Fecal Coliform Permit Limit (counts/100 mL)			Permit Flow Limit (mgd)	Receiving Water
		Minimum	Average	Maximum		
Chipley Water & Sewer System	FL0027570	_	200	800	1.2	Alligator Creek

The PCS database revealed four significant permit violations that occurred at the Chipley Water and Sewer System. A list of the violation dates and the percent of standard exceedance at the Chipley System are shown in Table 4-2. It is important to note that these observations are limited to data obtained from PCS.

Table 4-2. Frequency of permit violations by point source dischargers within the Choctawhatchee River watershed with respect to coliform limits

Facility	NPDES No.	Date	Measured value (#/100 mL)	Percent Exceedance
Chipley Water and Sewer System	FL0027570	8/31/96	1,600	100
		10/31/96	2,400	200
		12/31/96	2,400	200
		9/30/97	2,400	200

4.2 ASSESSMENT OF NONPOINT SOURCES

Nonpoint sources of fecal coliform bacteria are typically separated into urban and rural components. Urban settings are typically characterized by larger areas of paved impervious surfaces. Important sources of bacteria loads in urban areas are storm runoff from impervious areas, failing septic tanks, and leaking sanitary sewer systems. In rural settings, the amount of impervious area is usually much lower, resulting in greater infiltration of precipitation and less runoff. Sources of fecal coliform in rural areas may include runoff from fields receiving land application of animal wastes, runoff from concentrated animal operations, contributions from wildlife, cattle in the stream, and failing septic tanks (IFAS, 1998).

Potential sources of nonpoint pollution in the Choctawhatchee basin include runoff from pasture lands, failing septic systems, wildlife and cattle watering in stream reaches. It is difficult to identify potential specific nonpoint sources because specific information on agricultural management practices and activities and septic system functions is not readily available.

Septic systems are common in unincorporated portions of the watershed and may be direct or indirect sources of bacterial pollution via ground and surface waters. A high percentage of the citizens in Freeport, Santa Rosa Beach, Hogtown, and LaGrange Bayous rely on septic systems for wastewater treatment (FDEP, 1998).

The watersheds of the four 303(d)-listed segments were divided into subwatersheds to spatially evaluate pollutant sources and loading and to more accurately represent the stream systems by isolating main tributaries and stream segments. Florida provided GIS data layers of delineated subwatersheds for the state, providing a basis for subwatershed delineation for this study. Each listed watershed was evaluated and subwatersheds were determined based on the Florida subwatersheds, the location of monitoring stations, and the distribution of land use. Figures 4-1 through 4-4 present the subwatersheds for each of the 303(d)-listed segments evaluated in this study for the Choctawhatchee River watershed.

Some of the listed segments are tributaries to other listed segments. Therefore, some listed segments are delineated within the larger watershed.

Watershed information available for the Choctawhatchee River watershed was evaluated to identify and quantify sources of bacteria within the watersheds of the listed segments. The identified nonpoint sources of fecal coliform bacteria within the watersheds of the listed segments include

- Runoff from pasturelands with grazing livestock
- Runoff from cropland
- Failing septic systems
- Wildlife contributions
- Cattle in the stream.

Other sources include runoff from residential and urban areas. The following sections provide information on the characterization and quantification of bacteria sources within each listed watershed.

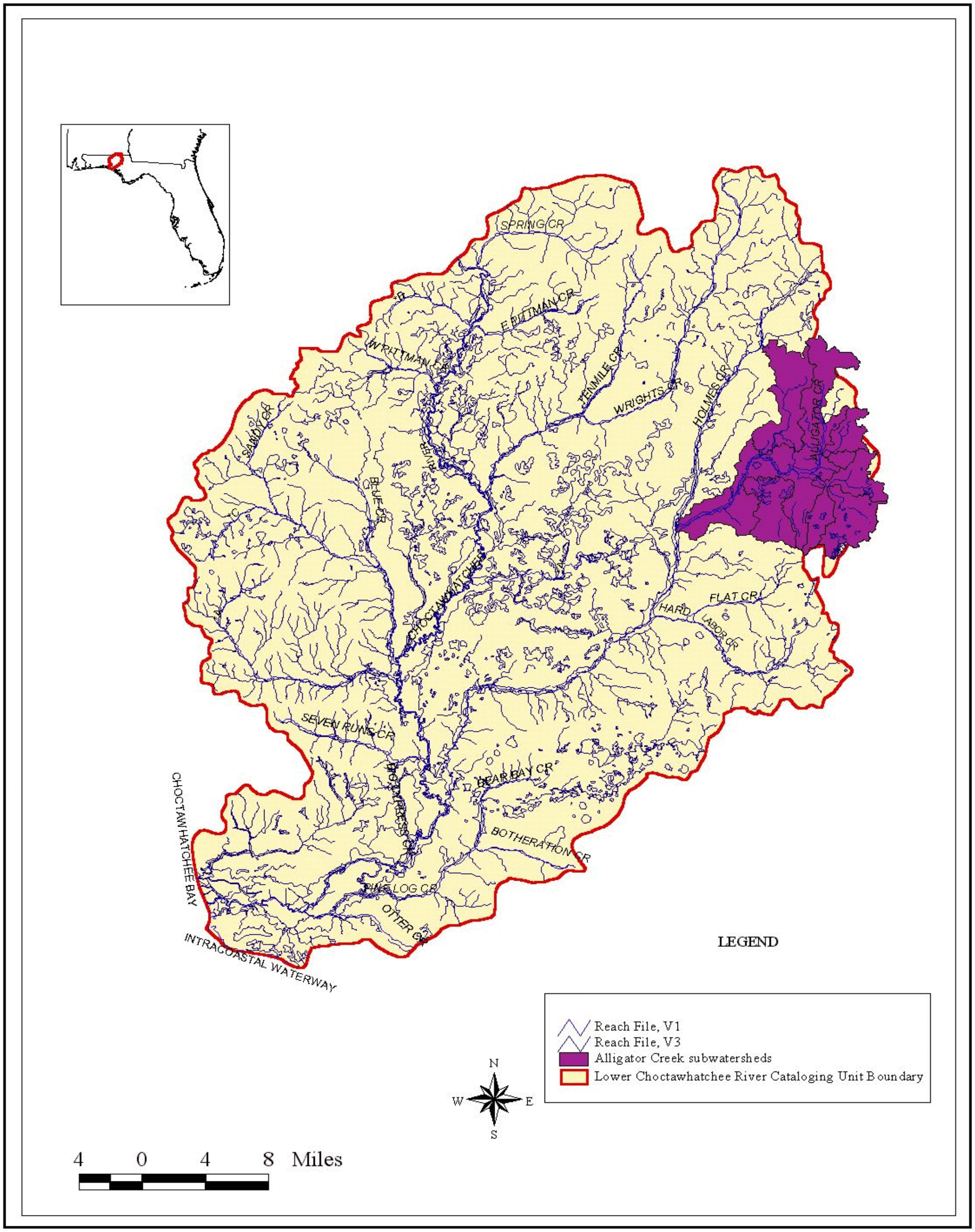


Figure 4-1. Alligator Creek subwatersheds within the Choctawhatchee River watershed

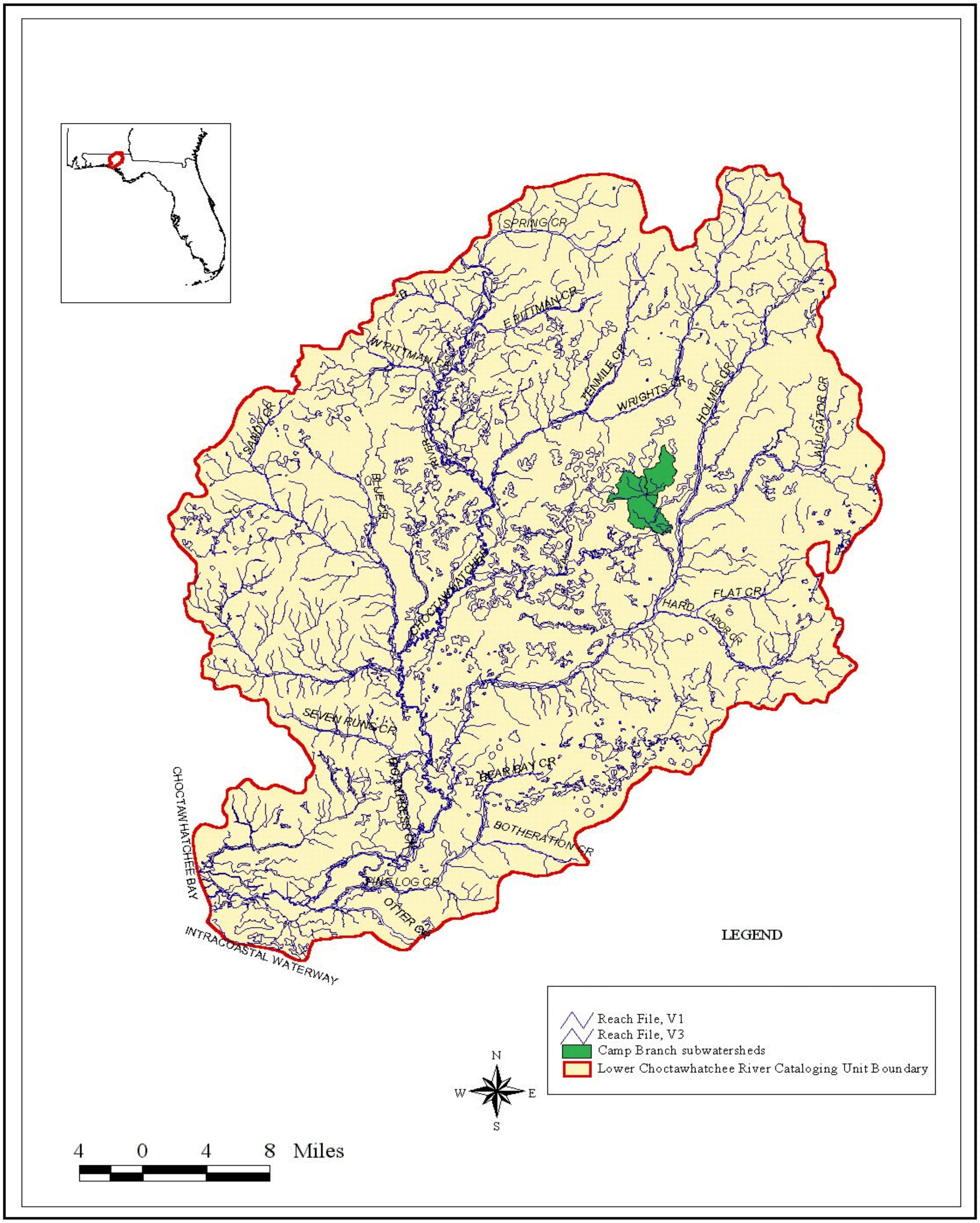


Figure 4-2. Camp Branch subwatersheds within the Choctawhatchee River watershed

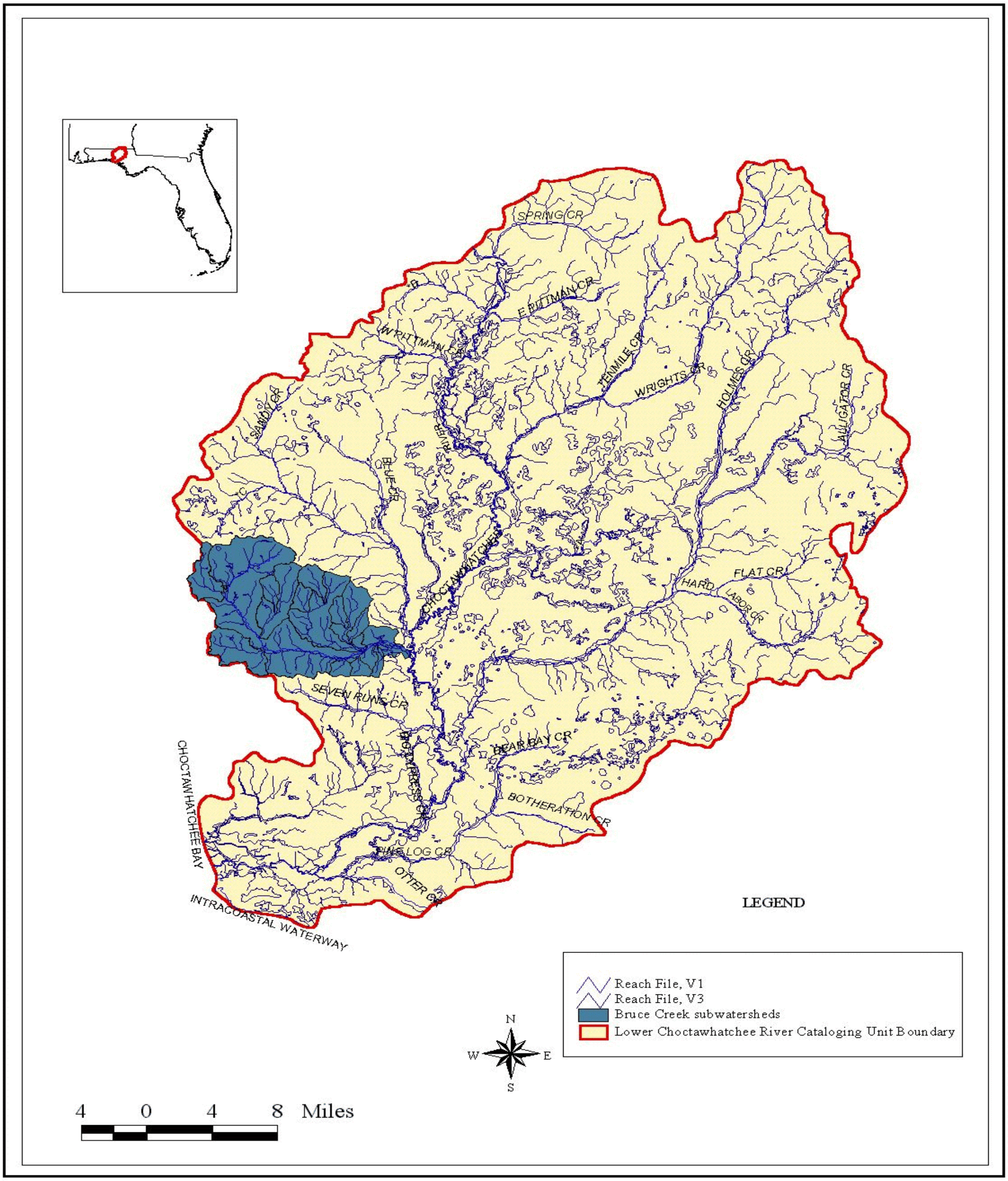


Figure 4-3. Bruce Creek subwatersheds within the Choctawhatchee River watershed

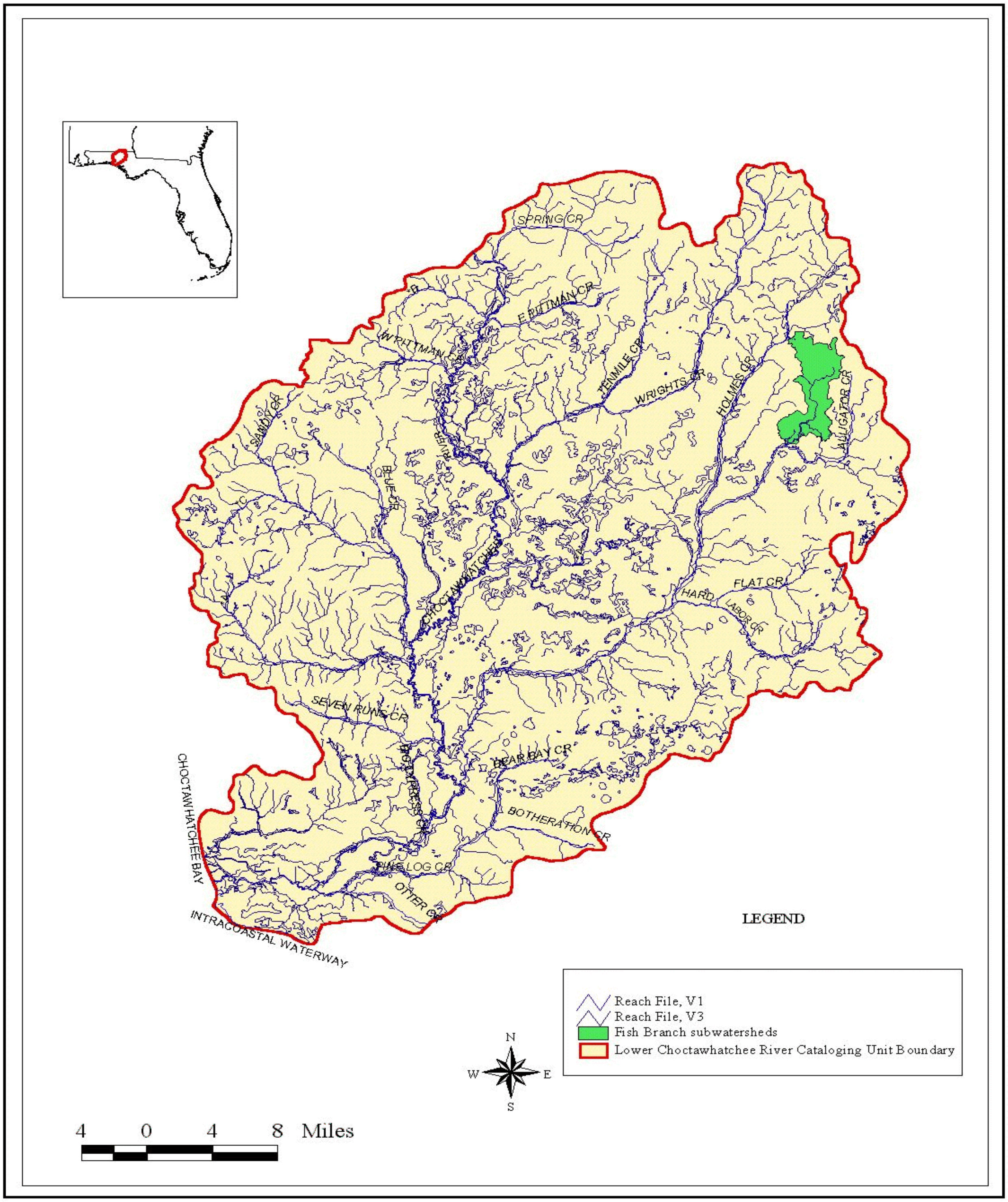


Figure 4-4. Fish Branch subwatersheds within the Choctawhatchee River watershed

4.2.1 Grazing Livestock

Grazing cattle and other agricultural animals deposit manure and, therefore, fecal coliform on the land surface, where it is available for washoff and delivery to receiving waterbodies. Grazing animals in the watersheds of the Choctawatchee River contribute fecal coliform accumulation to Pasture land use. Data from the 1997 Census of Agriculture provided numbers of livestock in each county covering portions of the watersheds, as well as total pastureland within each county. The livestock counts and pasture areas were used to determine livestock densities (e.g., number of cows per acres of pastureland) for each county, assuming livestock are evenly distributed over pasture area in the county. The area of pastureland in each subwatershed was determined using GIS data layers. The pasture area of the subwatershed and the livestock density for the counties were used to calculate the livestock counts within the subwatershed. The watersheds of Camp Branch, Fish Branch, and Bruce Creek are all contained within a single county; however, the Alligator Creek watershed is in three counties—Holmes, Jackson, and Washington. If pasture land in a subwatershed covered more than one county, the average livestock density of the multiple counties was applied to the pasture area to estimate the livestock count in that subwatershed. For example, the Alligator 9 subwatershed in the Alligator Creek watershed contains 294.92 acres of pasture area that crosses both Jackson and Holmes counties. The density of beef cows is 0.317 cows/acre in Jackson County and 0.313 cows/acre in Washington County. Therefore, the total number of beef cows in the Alligator 9 subwatershed is

$$294.92\ acres \times \frac{0.317+0.313}{2}\ cows/acre = 93\ cows$$

The subwatershed livestock counts for the major listed watersheds are presented in the following sections.

Estimates for hogs and chickens are included in the following tables although originally it was assumed that there are not many hog or chicken farms in the watersheds based on personal communication with NRCS. Therefore, hogs and chickens are not considered to be significant sources of fecal coliform bacteria to the waterbodies. Also the counties of Escambia, Covington, Jackson, and Walton did not have Ag Census data for chickens, so the watersheds in those respective counties do not have livestock counts for chickens.

Bruce Creek

Table 4-3 presents the livestock counts for each subwatershed within the Bruce watershed.

Table 4-3. Livestock counts for subwatersheds within the Bruce watershed

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/ Lambs	Hogs	Chickens
1	Bruce 1	28.56	13	6	0	0	0	---
2	Bruce 2	151.95	68	30	0	0	1	---
3	Bruce 3	462.88	208	90	1	1	4	---
4	Bruce 4	323.38	146	63	1	1	2	---
5	Bruce 5	7.52	3	1	0	0	0	---
6	Bruce 6	42.34	19	8	0	0	0	---
7	Bruce 7	130.51	59	25	0	0	1	---
8	Bruce 8	256.93	116	50	0	1	2	---
9	Bruce 9	0.00	0	0	0	0	0	---
10	Bruce 10	553.99	249	108	1	1	4	---
11	Bruce 11	65.77	30	13	0	0	1	---
12	Bruce 12	30.43	14	6	0	0	0	---
13	Bruce 13	44.01	20	9	0	0	0	---
TOTAL		2098	945	409	3	6	16	---

— indicates no information available

Camp Branch

Table 4-4 presents the livestock counts for each subwatershed within the Camp Branch watershed.

Table 4-4. Livestock counts for subwatersheds within the Camp Branch watershed

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs	Hogs	Chickens
1	Camp 1	10.94	6	3	0	0	0	45
2	Camp 2	304.86	174	83	13	1	7	1266
3	Camp 3	158.89	91	43	7	1	4	660
4	Camp 4	68.26	39	19	3	0	2	283
5	Camp 5	100.12	57	27	4	0	2	416
6	Camp 6	10.13	6	3	0	0	0	42
7	Camp 7	192.59	110	52	8	1	4	799
8	Camp 8	7.77	4	2	0	0	0	32
9	Camp 9	23.51	13	6	1	0	1	98
10	Camp 10	13.45	8	4	1	0	0	56
11	Camp 11	4.01	2	1	0	0	0	17
12	Camp 12	0.00	0	0	0	0	0	0
13	Camp 13	44.55	25	12	2	0	1	185
TOTAL		939.09	535	255	39	3	21	3898

Fish Branch

Table 4-5 presents the livestock counts for each subwatershed within the Fish Branch watershed.

Table 4-5. Livestock counts for subwatersheds within the Fish Branch watershed

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs[a]	Hogs
1	Fish 1	189.88	118	60	7	0	35
2	Fish 2	68.56	43	22	2	0	13
3	Fish 3	27.20	17	9	1	0	5
4	Fish 4	66.18	41	21	2	0	12
TOTAL		351.82	218.28	111.46	12.73	0.39	66

[a] Numbers for sheep were not available in the Census of Agriculture for Jackson County, FL, for 1997. Counts used to calculate livestock in subwatershed portions within Jackson County represent 1992 data. No information on chickens was available.

Alligator Creek

Table 4-6 presents the livestock counts for each subwatershed within the Alligator watershed.

Table 4-6. Livestock counts for subwatersheds within the Alligator watershed

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs[a]
1	Alligator 1	1066.10	660	336	42	3
2	Alligator 2	559.17	346	175	24	3
4	Alligator 4	221.66	137	69	9	1
5	Alligator 5	353.37	218	111	15	2
6	Alligator 6	1217.46	752	381	52	6
7	Alligator 7	296.63	183	93	13	2
8	Alligator 8	472.94	292	148	20	3
9	Alligator 9	294.92	183	93	12	1
10	Alligator 10	614.21	380	192	26	3
11	Alligator 11	300.45	186	95	11	0
12	Alligator 12	129.69	77	38	5	0
13	Alligator 13	812.21	502	254	35	4
14	Alligator 14	221.66	137	69	9	1
15	Alligator 15	807.84	500	254	32	3
16	Alligator 16	380.03	235	120	15	1
17	Alligator 17	169.19	105	53	7	1
18	Alligator 18	554.26	343	173	24	3
TOTAL		8472	5237	2655	350	38

[a] Numbers for sheep were not available in the Census of Agriculture for Escambia County, AL, for 1997. Counts used to calculate livestock in subwatershed portions within Escambia County represent 1992 data. No data were available for hogs and chickens.

4.2.2 Failing Septic Systems

Onsite septic systems have the potential to deliver bacteria loads to surface waters due to system failure and malfunction. NSFC (1993) provided estimates of failing septic systems for each county within the Choctawhatchee River watersheds. The fraction of failing systems in each subwatershed was then estimated based on subwatershed area and density of failing systems in each county. Without knowing the spatial distribution of septic systems, functioning or failing, it was assumed that failing systems are distributed evenly throughout their corresponding counties. A density of failing septic systems (number per acre) was determined for each county by dividing the number of failing systems by the county area. The densities were then applied to the area of the subwatershed to determine the number of failing systems in the subwatershed. In cases where the subwatershed is not contained within a single county (e.g., Alligator Creek watershed), the county densities of failing systems were averaged and the average was applied to the subwatershed area. [It should be noted that there was no information on failing septic counts for Washington County in NFSC (1993). The average of the surrounding county densities was used to estimate the number of failing septic systems in areas within Washington County.] The septic failure rates for Holmes, Geneva, Washington, Walton, and Jackson counties are 1.12 percent, 0.41 percent, 0.76 percent, 0.09 percent, and 1.66 percent, respectively.

The following sections present the estimates of the number of failing septic systems in the subwatersheds within each listed watershed.

Bruce Creek

Table 4-7 presents the number of failing septic systems for each subwatershed within the Bruce Creek watershed.

Table 4-7. Inventory of failing septic systems in the subwatersheds of the Bruce Creek watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems (See text in Sec. 4.2.2)
1	Bruce 1	1974.08	0.03
2	Bruce 2	2824.73	0.04
3	Bruce 3	5593.79	0.08
4	Bruce 4	8422.78	0.12
5	Bruce 5	3319.46	0.05
6	Bruce 6	2121.62	0.03
7	Bruce 7	5030.45	0.07
8	Bruce 8	8844.39	0.13
9	Bruce 9	199.76	0.00
10	Bruce 10	5213.56	0.08
11	Bruce 11	4141.26	0.06
12	Bruce 12	501.87	0.01
13	Bruce 13	6116.92	0.09
TOTAL		54304.67	0.79

Camp Branch

Table 4-8 presents the number of failing septic systems for each subwatershed within the Camp Branch watershed.

Table 4-8. Inventory of failing septic systems in the subwatersheds of the Camp Branch watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems (See text in Sec. 4.2.2)
1	Camp 1	852.86488	0.16
2	Camp 2	2410.3701	0.46
3	Camp 3	1196.2807	0.23
4	Camp 4	264.44693	0.05
5	Camp 5	791.35612	0.15
6	Camp 6	84.660033	0.02
7	Camp 7	2613.0923	0.50
8	Camp 8	240.15736	0.05
9	Camp 9	399.63806	0.08
10	Camp 10	231.12064	0.04
11	Camp 11	257.80385	0.05
12	Camp 12	0.4872164	0.00
13	Camp 13	509.6906	0.10
TOTAL		9851.9688	2

Fish Branch

Table 4-9 presents the number of failing septic systems for each subwatershed within the Fish Branch watershed.

Table 4-9. Inventory of failing septic systems in the subwatersheds of the Fish Branch watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems (See text in Sec. 4.2.2)
1	Fish 1	840.25	0.27
2	Fish 2	377.03	0.12
3	Fish 3	645.46	0.20
4	Fish 4	346.80	0.11
TOTAL		2209.54	0.7

Alligator Creek

Table 4-10 presents the number of failing septic systems for each subwatershed within the Alligator Creek watershed.

Table 4-10. Inventory of failing septic systems in the subwatersheds of the Alligator Creek watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems (See text in Sec. 4.2.2)
1	Alligator 1	7772.8826	1.98
2	Alligator 2	3233.7757	0.63
4	Alligator 4	845.76	0.27
5	Alligator 5	1621.51	0.51
6	Alligator 6	5830.0513	1.14
7	Alligator 7	2080.9864	0.41
8	Alligator 8	2165.9387	0.42
9	Alligator 9	1845.299	0.47
10	Alligator 10	3109.8162	0.61
11	Alligator 11	3445.1754	1.09
12	Alligator 12	1709.1034	0.54
13	Alligator 13	4090.7633	0.80
14	Alligator 14	845.76173	0.16
15	Alligator 15	6333.1722	1.62
16	Alligator 16	4005.3595	1.02
17	Alligator 17	1278.7381	0.33
18	Alligator 18	2190.0828	0.43
TOTAL		49936.91	12

The fecal coliform loading rates from failing septic systems used in developing the TMDLs for the Choctawhatcheee River watershed are presented in Table C-1 in Appendix C.

4.2.3 Wildlife

Wildlife is another potential source of fecal coliform loading to receiving waterbodies. It is assumed that deer habitat within the watershed includes Forest/Vegetated, Cropland, Wetlands, Open Land, and Pasture land uses. Typical estimates for distributions of deer within the region were provided by the Florida Fish and Wildlife Conservation Commission (personal communication, August 27, 1999). Three different densities (deer per square mile) were available for the region, representing different management areas. Estimates are determined based on "track estimates" where the ground is cleared, and then animal tracks are counted to estimate populations within an area. The provided densities were applied to deer habitat areas within the watershed to estimate population counts by subwatershed. The highest density (5.8 deer/mi^2) was applied to the Forest/Vegetated, Cropland, and Wetlands areas, and the lower density (2.9 deer/mi^2) was applied to Open Land and Pasture areas. The following sections present the inventories of deer in each subwatershed by land use considered deer habitat.

Bruce Creek

Table 4-11 presents the wildlife counts by land use for each subwatershed within the Bruce Creek watershed.

Table 4-11. Wildlife counts for each subwatershed within the Bruce Creek watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
1	Bruce 1	0	11	0	0	5	16
2	Bruce 2	2	15	0	1	2	20
3	Bruce 3	5	37	0	2	3	47
4	Bruce 4	4	48	0	1	6	59
5	Bruce 5	0	26	0	0	3	29
6	Bruce 6	0	15	0	0	2	17
7	Bruce 7	1	39	0	1	3	44
8	Bruce 8	3	67	0	1	4	75
9	Bruce 9	0	1	0	0	0	1
10	Bruce 10	6	32	0	3	1	42
11	Bruce 11	1	31	0	0	3	35
12	Bruce 12	0	4	0	0	0	4
13	Bruce 13	1	49	0	0	3	53
TOTAL		24	376	0	10	36	446

Camp Branch

Table 4-12 presents the wildlife counts by land use for each subwatershed within the Camp Branch watershed.

Table 4-12. Wildlife counts for each subwatershed within the Camp Branch watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
1	Camp 1	0	2	0	0	1	3
2	Camp 2	4	12	0	1	2	19
3	Camp 3	2	5	0	1	1	9
4	Camp 4	1	1	0	0	0	2
5	Camp 5	1	2	0	0	0	3
6	Camp 6	0	0	0	0	0	0
7	Camp 7	1	15	0	1	5	22
8	Camp 8	0	1	0	0	1	2
9	Camp 9	0	2	0	0	1	3
10	Camp 10	0	1	0	0	1	2
11	Camp 11	0	2	0	0	0	2
12	Camp 12	0	0	0	0	0	0
13	Camp 13	0	3	0	0	1	53
TOTAL		10	46	0	4	12	72

Fish Branch

Table 4-13 presents the wildlife counts by land use for each subwatershed within the Fish Branch watershed.

Table 4-13. Wildlife counts for each subwatershed within the Fish Branch watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
1	Fish 1	4	1	0	1	0	6
2	Fish 2	1	1	0	0	0	2.0200
3	Fish 3	1	4	0	0	1	6
4	Fish 4	1	0	0	0	0	1
TOTAL		7	6	0	1	1	15.0200

Alligator Creek

Table 4-14 presents the wildlife counts by land use for each subwatershed within the Alligator Creek watershed.

Table 4-14. Wildlife counts for each subwatershed within the Alligator watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
1	Alligator 1	19	26	0	5	13	63
2	Alligator 2	8	13	0	3	2	26
4	Alligator 4	3	1	0	1	1	6
5	Alligator 5	5	6	0	2	0	13
6	Alligator 6	18	17	0	6	4	45
7	Alligator 7	4	8	0	1	2	15
8	Alligator 8	7	6	0	2	1	16
9	Alligator 9	5	7	0	1	2	15
10	Alligator 10	9	11	0	3	2	25
11	Alligator 11	6	8	0	1	3	18
12	Alligator 12	2	9	0	1	3	15
13	Alligator 13	12	12	0	4	5	33
14	Alligator 14	3	1	0	1	1	6
15	Alligator 15	17	19	0	4	11	51
16	Alligator 16	8	13	0	2	5	28
17	Alligator 17	4	4	0	1	2	11
18	Alligator 18	8	5	0	3	1	17
TOTAL		130	159	0	38	57	384

4.2.4. Cattle in the Stream

When cattle are not denied access to stream reaches, they represent a potential source of fecal coliform loading directly to the stream. To account for the potential influence of cattle loads deposited directly in stream reaches within the watersheds, fecal coliform loads from cattle in streams were calculated and characterized as a direct source of loading to the stream segments. To determine the number of cows in the stream at any time, it was assumed that 10 percent of the cows in the watershed have access to streams; that 7 percent of those cows are in or around the stream at any given time; and that 5 percent of those cows in the stream are actually depositing manure in the stream reach at any given time. The fecal coliform loading rates for cattle in the stream used in developing the TMDLs for the Choctawhatchee River watershed are presented in Table C-2 in Appendix C.

4.2.5 Critical Conditions

While selecting a numeric endpoint, TMDL developers must also select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions.

Critical conditions for waters impacted by nonpoint sources generally occur during wet weather when storm events cause surface runoff to carry pollutants to waterbodies. Therefore, the selected condition may be a rainfall event with a particular intensity and duration that reoccurs at a specific frequency. Critical conditions for systems mainly impacted by point sources and failing septics generally occur during low flow (i.e., low dilution) conditions when little or no land-based runoff is occurring. For example, the critical condition for controlling a continuous point discharge may be drought stream flow. Pollution controls designed to meet water quality standards for drought flow will ensure compliance with standards for all flows greater than drought.

Because the majority of available water quality monitoring data for the Choctawhatchee River watershed do not have corresponding flow measurements, it is difficult to evaluate critical flow conditions. Without corresponding flow values, it is impossible to determine whether elevated bacteria levels occur during base flow or during high flow.

The only available flow data corresponding to measured coliform values is from the USGS gage 02366500, which is on the Choctawhatchee River near Bruce, Florida. This station is not located on one of the listed segments and may be subject to estuarine influences, but may represent general hydrologic and loading conditions of the upstream listed segments. Unfortunately, the data do not clearly indicate a relationship between flow and instream fecal coliform levels. As presented in Figure 4-5, there appears to be a relationship with higher flows corresponding to higher fecal coliform levels, but this relationship is not consistent.

Another consideration when evaluating critical conditions is seasonality. Samples are collected quarterly at several of the monitoring stations in the watershed, providing fecal coliform samples during different times of the year. These data do not suggest any seasonal pattern of instream coliform levels. However, available data do not provide consistent records of coliform levels during and across seasons. Nor do they have corresponding flow values. Seasonal differences in coliform levels could be caused by seasonal variations in precipitation and climate or by seasonal differences in activities in the watershed (e.g., land application of waste, recreational activities, etc.). However, without flow values or multiple water quality samples, it is difficult to evaluate the existence of or causes for seasonal variation.

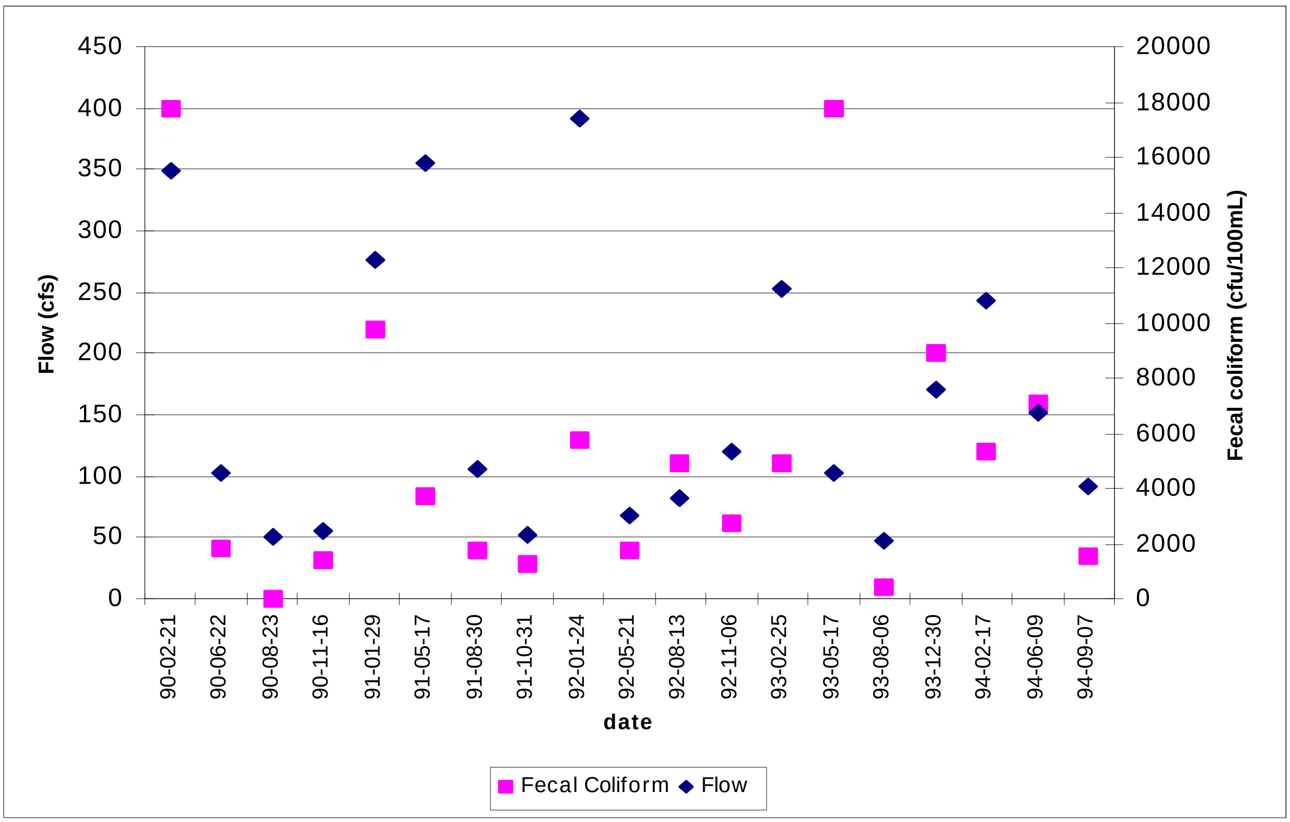


Figure 4-5. Flow and fecal coliform values at USGS gage 02366500 (1990-1994)

During calibration and establishment of existing conditions in the model, the model was run for a 15-year period (1980-1995) representing a time period of varying hydrologic and climatic conditions. When evaluating potential allocation time periods, the more recent time period of 1990 through1995 was evaluated. Model output for 1993 was used for evaluation of allocation scenarios because modeled water quality during 1993 represented the worst conditions during the 5-year period, with the highest concentrations in magnitude. Allocations are determined on a 30-day basis for 1993 to meet the geometric mean standard of 200 counts/100 mL.

5.0 LINKAGE OF SOURCES AND WATER QUALITY RESPONSE

5.1 SELECTED WATERSHEDS

There are four segments on the mainstem of or tributaries to the Choctawhatchee River that are listed on Florida's 1998 303(d) list as impaired by fecal coliform and considered for TMDL development in this study. This section presents the technical approach for developing fecal coliform TMDLs for the following impaired waters within the Choctawhatchee River watershed.

- Alligator Creek
- Bruce Creek
- Camp Branch
- Fish Branch

5.2 TMDL ENDPOINT

Because the water quality standards that apply to the Choctawhatchee River and its tributaries have numeric criteria for fecal coliform, those numeric criteria can be used to represent the instream water quality target for the TMDLs. The coliform TMDLs within the Choctawhatchee River watershed will establish wasteload and load allocations that are designed to attain the applicable fecal coliform bacteria water quality standards of a monthly average of 200 counts/100 mL, expressed as a geometric mean based on a minimum of 10 samples taken over a 30-day period. The model output provides continuous daily concentrations to compare to this endpoint. To provide a margin of safety (Section 6.2), the TMDL water quality target was set at a geometric mean of 190#/100mL, 5 percent lower than the standard of 200#/100mL.

5.3 LINKAGE OF SOURCES AND TMDL ENDPOINT

Establishing a relationship between the instream water quality target and source loadings is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions. The following sections discuss the modeling tools and model setup and application that are used to evaluate the relationship between water quality and source loads.

Fecal coliform TMDLs for Alligator Creek, Bruce Creek, Camp Branch and Fish Branch were determined using watershed/water quality modeling. The following sections discuss the modeling techniques and applications used to establish the TMDLs for Alligator Creek, Bruce Creek, Camp Branch and Fish Branch.

5.3.1 Modeling Framework

USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system Version 2.0 (USEPA, 1998a) and the Nonpoint Source Model (NPSM) were used to predict the significance of coliform sources and levels in the Choctawhatchee River watershed. BASINS is a multipurpose environmental analysis system for use in performing watershed and water quality-based studies. A geographic information system (GIS) provides the integrating framework for BASINS and allows for the display and analysis of a wide variety of landscape information (e.g., land uses, monitoring stations, point source dischargers).

The NPSM simulates nonpoint source runoff from selected watersheds, as well as the transport and flow of pollutants through stream reaches. BASINS produces time series data, allowing for sufficient data to compare to the water quality target in the analysis. Another key reason for using BASINS as the modeling framework is its ability to integrate both point and nonpoint source simulation, as well as its ability to assess instream water quality response.

5.3.2 Model Setup

The watersheds of the 303(d)-listed segments were divided into subwatersheds to spatially evaluate pollutant sources and loading and to more accurately represent the stream systems. Stream network segmentation and subwatershed delineation for this study were preliminarily based on GIS data layers of delineated subwatersheds provided by FDEP. Each listed watershed was evaluated, and subwatersheds were finalized based on the Florida subwatersheds, topography, location of monitoring stations, and distribution of land use. (Figures 4-1 through 4-4 present the subwatersheds for each of the 303(d)-listed segments.)

Using the subwatershed delineations, reach networks within the model were established for the listed watersheds with corresponding reach characteristics (e.g., width, depth, length, slope, elevations). For subwatersheds based on RF1 reach segments, reach characteristics could be pulled from RF1 attribute tables. Reach characteristics for RF3 reaches were estimated based on reach network, elevation and topography coverages. Stream cross-section dimensions, including width and depth, were developed using regional curves that relate watershed size to stream cross section (Rosgen, 1996). The functions used to estimate the stream depth and width of the RF3 reaches are:

$$d = 1.4995 * A^{0.2838}$$

where *d* is the stream depth in feet and *A* is the upstream watershed area in square miles, and

$$w = 14.49\ 8\ A^{0.40}$$

where *w* is the stream width in feet and *A* is the upstream watershed area in square miles. Some reach characteristics were adjusted to result in appropriate flow output and model response.

5.3.3 Hydrologic Calibration

The modeling time period was selected as 1975 -1995, in order to represent a range of hydrologic and climatic conditions. After developing the model to represent source contributions and in-stream response, the model was calibrated. The first step was to calibrate hydrology. Hydrology calibration involved comparison of modeled flow to observed flow at USGS gage 02370000 for 1979. This gage was assumed to be representative of hydrologic condition throughout the Choctawhatchee watershed (see Figure 5-1). The year 1979 was selected because it represented a full range of hydrologic conditions.

The overall water balance, flow during storm events, and seasonal flow balance were examined. Various hydrologic parameters representing infiltration, interflow, groundwater, storage, and evapotranspiration were adjusted to calibrate modeled flows to existing flows. The simulated flows are plotted with the observed flows in Figure 5-2. In addition to visual comparison, statistical comparisons were made between daily model output and existing flow data. Results of the data comparison are presented in Table 5-1. As indicated in Table 5-1, the differences between simulated flows and existing flows are generally within the recommended ranges.

Table 5-1. Results of data comparison of simulated and observed flows (in cfs) within the calibration watershed.

Calculation	Simulated	Observed	Error	Recommended Error [a]
Total flow volume	62.84	61.69	1.83 %	10 %
Total of lowest 50% of flows	12.71	12.17	4.24 %	10 %
Total of highest 10% of flows	28.61	24.91	12.93 %	15 %
Summer flow volume	10.75	11.39	-5.93 %	30 %
Fall flow volume	8.66	9.81	-13.34 %	30 %
Winter flow volume	6.50	6.63	-2.10 %	30 %
Spring flow volume	36.94	33.86	8.34 %	30 %
Total storm volume	49.53	41.78	15.64 %	20 %
Summer storm volume	7.51	6.40	14.87 %	50 %

[a] Recommended error suggested in Lumb et al. (1994).

To represent the weather throughout the watershed, the Wausau weather station in FL was used in the model. The hourly precipitation data for this station contained various intervals of accumulated, missing, or deleted data. Accumulated data represent cumulative precipitation over several hours, but the exact hourly distribution of the data is unknown. Accumulated, missing, and deleted data records were repaired based on hourly rainfall patterns at nearby stations with unimpaired data. These intervals were patched using the *normal-ratio method*, which

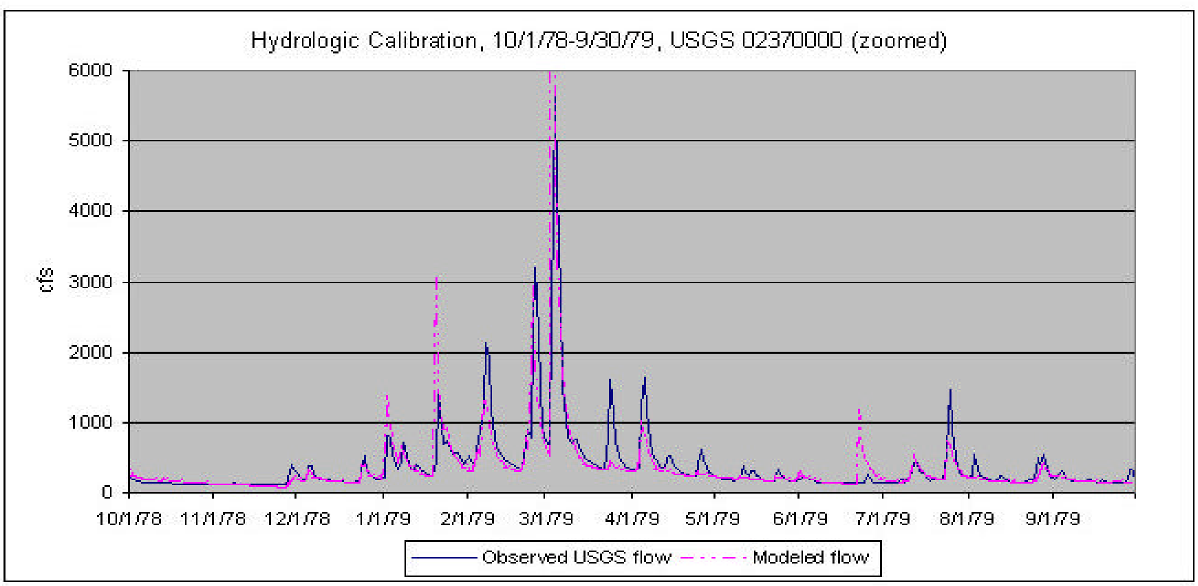


Figure 5-1. Observed and simulated flows at USGS gage 02370000, Blackwater River near Baker, Florida

estimates a missing rainfall record with a weighted average from surrounding stations with similar rainfall patterns according to the relationship

$$P_A = \frac{1}{n} \left(\sum_{i=1}^{n} \frac{N_A}{N_i} P_i \right)$$

where P_A is the impaired precipitation value at station A, n is the number of surrounding stations with unimpaired data at the same specific point in time, N_A is the long-term average precipitation at station A, N_i is the long-term average precipitation at nearby station i, and P_i is the observed precipitation at nearby station i. For each impaired data record at station A, n consists of only the surrounding stations with unimpaired data; therefore, for each record, n varies from 1 to the maximum number of surrounding stations. When no precipitation is available at the surrounding stations, zero precipitation is assumed at station A. The US Weather Bureau has a long-established practice of using the long-term average rainfall as the precipitation normal. This method is adaptable to regions where there is large orographic variation in precipitation.

5.3.4 Source Representation

Point Sources

All identified point and nonpoint sources within the selected watersheds were represented in the model. Discharge monitoring reports (DMRs) and any other available data were used to characterize the point source effluent.

Nonpoint Sources

The nonpoint sources within the Choctawhatchee River watersheds are represented differently in the model depending on their type and behavior. The following nonpoint sources have been identified within the listed watersheds:

- General land-based runoff
- Grazing livestock
- Wildlife
- Failing septic systems
- Cattle in the stream reaches

Typically, nonpoint sources are characterized by buildup and washoff processes: they contribute bacteria to the land surface, where they accumulate and are available for runoff during storm events. These nonpoint sources can be represented in the model as land-based runoff from the land use categories to account for their contribution to coliform loading within the watersheds. Fecal coliform accumulation rates (number per acre per day) can be calculated for each land use based on all sources contributing coliform to the surface of the land use. For this study, where specific sources were identified as contributing to a land use, accumulation rates were calculated. For example, grazing livestock and wildlife are specific sources contributing to land uses within the watershed. The land uses that experience bacteria accumulation due to livestock and wildlife include

- Cropland (wildlife)
- Forest/Vegetated (wildlife)
- Open Land (wildlife)
- Pasture (livestock and wildlife)
- Wetlands (wildlife)

Accumulation rates were specifically calculated for these land uses based on the distribution of animals by land use for each subwatershed (see Section 4) and using typical fecal coliform production rates for different animal types (Table 5-2). For example, the coliform accumulation rate for pasturelands is the sum of the individual coliform accumulation rates due to contributions from grazing livestock (including milk and beef cattle, sheep, and horses) and wildlife.

Table 5-2. Fecal coliform production rates for various animals

Animal	Fecal Coliform Production Rate	Reference
Milk cow	7.1×10^{10} counts/day	ASAE, 1998
Beef cow	6.98×10^{10} counts/day	ASAE, 1998
Sheep	1.8×10^{10} counts/day	Metcalf & Eddy, 1991
Hog	8.9×10^{9} counts/day	Metcalf & Eddy, 1991
Deer	5×10^{8} counts/day	Linear interpolation; Metcalf & Eddy, 1991

Other land use types did not specify sources identified as contributing fecal coliform to their surface. Literature values for typical fecal coliform accumulation rates were used for those land uses—Urban, Residential, and Other.

The literature value used for residential land uses is 1.43 E+07 #/ac/day, the average of the default values for low- and high-density residential areas (Horner, 1992). The literature value used for urban land uses is the median default value of 6.19 E+06 #/ac/day for commercial land (Horner, 1992). It is assumed that the "other" land use is half the load from low-density residential, therefore, the value used to represent fecal coliform accumulation rates on other land is 5.14 E+06 #/ac/day.

Failing septic systems represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface or subsurface malfunctions. The estimation of number of failing septic systems is discussed in Section 4.2.2. To provide for a margin of safety accounting for the uncertainty of the number, location, and behavior (e.g., surface vs. subsurface breakouts; proximity to stream) of the failing systems, failing septic systems are represented in the model as direct sources of fecal coliform to the stream reaches. Fecal coliform contributions from failing septic system discharges are included in the model with a representative flow and concentration, which were quantified based on the following information:

- Number of failing septic systems in each subwatershed (as discussed in Section 4.2.2).
- Estimated population served by the septic systems (average of county averages of people per household, obtained from 1990 Bureau of the Census data).
- An average daily discharge of 70 gallons/person/day (Horsley & Whitten, 1996).
- Septic effluent concentration of 10^4 cfu/100 mL (Horsley & Whitten, 1996).

The septic system contribution in the model inherently contains a margin of safety based on the assumption that all the fecal coliform bacteria discharged from failing septic systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after being filtered through the soil or after die-off during transport.

Cattle depositing manure directly into stream reaches also represent a direct nonpoint source of fecal coliform. The number of cattle producing and depositing fecal coliform in watershed streams at any give time were estimated, as discussed in Section 4.2.4. The cattle were then simulated in the model as direct sources of fecal coliform loads, with a representative flow rate (cubic feet per second) and load (counts per hour). The representative load was calculated based on the number of cows in the stream and the fecal coliform production rate for cows (Table 5-3). The flow was estimated based on the number of cows in the stream, the manure production rate of cows (ASAE, 1998) and the approximate density of cow manure.

5.3.5 Water Quality Calibration

After the hydrologic calibration was completed and sources were most appropriately characterized and represented in the model, the modeled in-stream fecal coliform concentrations were compared to available observed data. Parameters representing such processes as bacteria accumulation, bacteria storage, and interflow and groundwater concentrations were adjusted to calibrate modeled water quality to the observed ambient water quality data. There was a total of six available water quality monitoring stations in the Choctawhatchee watershed. Modeled water quality was compared to existing data at station 32020020 in the watershed. This station was chosen for calibration because it was located on a listed segment, had data available during the modeling time period, and had the largest number of samples of any of the stations (22).

In some cases, there was some uncertainty concerning the temporal comparison of modeled concentration peaks and observed peaks. The observed water quality represents an ambient concentration from a grab sample and the modeled water quality represents daily average concentrations. If there is a storm event during the sampling day, the grab sample may reflect a concentration on the rising or falling curve of the pollutograph or the peak storm concentration. To confirm calibration of the model's water quality and to avoid overestimation of the concentration peaks, daily output from the model were compared to the observed ambient data. Figure 5-2 presents calibrated daily modeled fecal coliform concentrations and observed fecal coliform concentrations at station 32020020 for 1995.

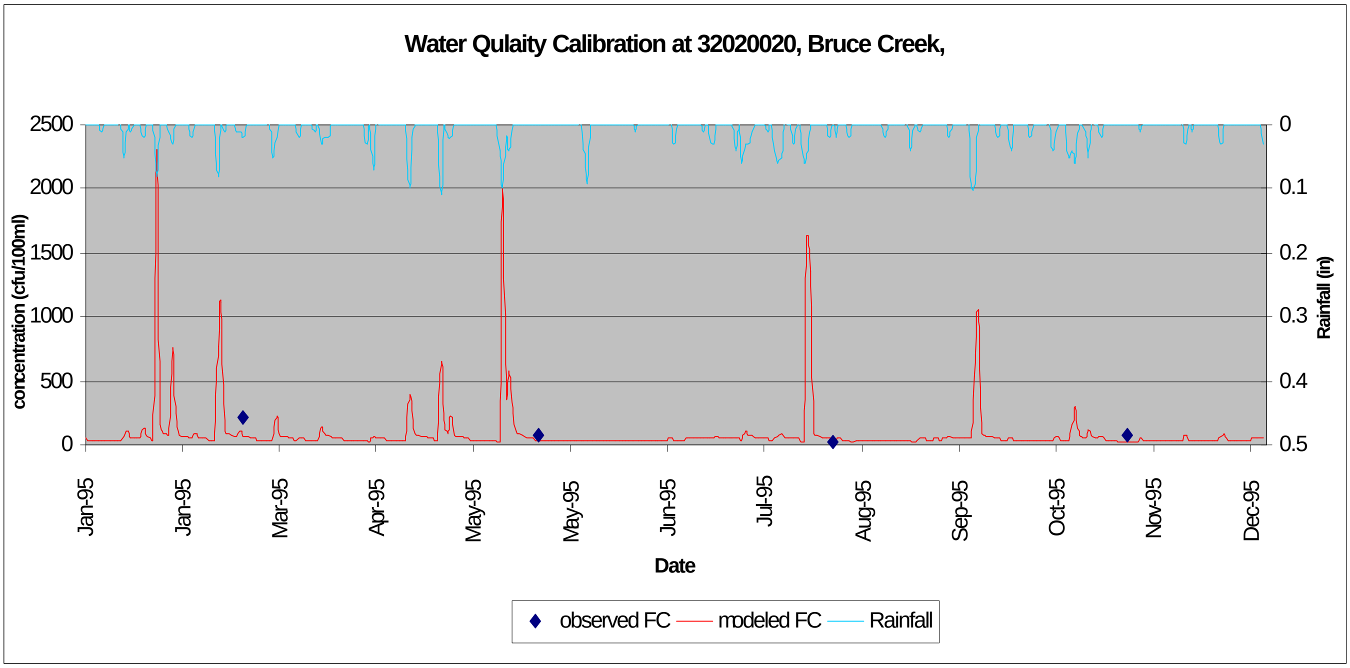


Figure 5-2. Observed and modeled fecal coliform concentrations at Station 32020020, Bruce Creek Hwy 81 North of Red Bay, Florida

6.0 TMDL

This section presents the TMDLs developed for fecal coliform for the Choctawhatchee River watershed—Alligator Creek, Bruce Creek, Camp Branch, and Fish Branch. The TMDLs are presented on a 30-day basis. Model output for 1993 was used to determine the TMDLs and allocation scenarios because modeled water quality during 1993 represented critical conditions during the modeling period. The years 1994 and 1995 also represented critical conditions, but were not chosen to determine TMDLs and allocation scenarios because of extreme weather conditions (i.e., tropical storm and hurricane) during these two years. The year 1993 was chosen to determine TMDLs and allocation scenarios because it was representative of more typical weather conditions. Allocations were determined on a 30-day basis for 1993 and represented compliance with the 200 counts/100 mL as a geometric mean standard (actually 190 counts/100 mL when considering the margin of safety).

The overall 30-day TMDL allocations are given separately for each watershed in the following tables. The contribution from each nonpoint and point source is specified and summed, giving the load allocation and wasteload allocation, respectively, which, when added to the explicit margin of safety, yields the TMDL.

Note that where load reductions are needed, most of the reduction is assigned to the "Cattle in the Stream" category. This is "a way" (not necessarily "the way") to achieve the reduction that was thought to be the least resource intensive and very compatible with commonly recognized BMPs. During implementation, other means of achieving needed load reductions could be substituted, if appropriate.

6.1 ALLIGATOR CREEK WATERSHED

The overall 30-day TMDL allocations for Alligator Creek are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Nonpoint Source			
Cropland	1.32 E+12	0.00%	1.32 E+12
Forest/Vegetated	1.98 E+12	0.00%	1.98 E+12
Open Land	8.92 E+09	0.00%	8.92 E+09
Other	5.26 E+09	0.00%	5.26 E+09
Pasture	6.12 E+13	0.00%	6.12 E+13
Residential	3.07 E+12	0.00%	3.07 E+12
Urban	2.82 E+10	0.00%	2.82 E+10
Wetlands	5.52 E+11	0.00%	5.52 E+11
Failing Septic Systems	2.55 E+10	0.00%	2.55 E+10
Cattle in the Stream	6.13 E+12	31.69%	4.18 E+12
Point Sources			
Chipley Water and Sewer System	2.45 E+11	0.00%	2.45 E+11
Total Existing Load	**7.18 E+13**	**Load Allocation**	**6.95 E+13**
Total Load Reduction = 2.79%		**Wasteload Allocation**	**2.45 E+11**
		Margin of Safety[1]	**3.67 E+12**
		TMDL = Loading Capacity =	**7.34 E+13**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.7.

6.2 BRUCE CREEK WATERSHED

The overall 30-day TMDL allocations for Bruce Creek are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Cropland	4.00 E+11	0.00%	4.00 E+11
Forest/Vegetated	6.24 E+12	0.00%	6.24 E+12
Open Land	5.48 E+09	0.00%	5.48 E+09
Other	2.94 E+10	0.00%	2.94 E+10
Pasture	1.01 E+13	0.00%	1.01 E+13
Residential	2.63 E+11	0.00%	2.63 E+11
Urban	7.66 E+11	0.00%	7.66 E+11
Wetlands	6.03 E+11	0.00%	6.03 E+11
Failing Septic Systems	1.69 E+09	0.00%	1.69 E+09
Cattle in the Stream	1.01 E+12	0.00%	1.01 E+12
Total Existing Load	**1.87 E+13**	**Load Allocation**	**1.87 E+13**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**1.24 E+12**
		Reserve for Future Growth/Activities	**4.98 E+12**
		TMDL = Loading Capacity =	**2.48 E+13**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.7.

[2] A Reserve for Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.8.

6.3 CAMP BRANCH WATERSHED

The overall 30-day TMDL allocations for Camp Branch are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Nonpoint Sources			
Cropland	1.38 E+11	0.00%	1.38 E+11
Forest/Vegetated	5.44 E+11	0.00%	5.44 E+11
Open Land	0.00 E+00	0.00%	0.00 E+00
Other	0.00 E+00	0.00%	0.00 E+00
Pasture	5.82 E+12	0.00%	5.82 E+12
Residential	5.93 E+10	0.00%	5.93 E+10
Urban	2.48 E+10	0.00%	2.48 E+10
Wetlands	1.44 E+11	0.00%	1.44 E+11
Failing Septic Systems	2.06 E+08	0.00%	2.06 E+08
Cattle in the Stream	6.17 E+11	9.49%	5.58 E+11
Total Existing Load	**7.35 E+12**	**Load Allocation**	**7.28 E+12**
Total Load Reduction = 0.78%		**Wasteload Allocation**	**0**
		Margin of Safety[1]	**3.83 E+11**
		TMDL = Loading Capacity =	**7.66 E+12**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.7.

6.4 FISH BRANCH WATERSHED

The overall 30-day TMDL allocations for Fish Branch Creek are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Cropland	8.75 E+10	0.00%	8.75 E+10
Forest/Vegetated	7.05 E+10	0.00%	7.05 E+10
Open Land	4.73 E+08	0.00%	4.73 E+08
Other	4.23 E+06	0.00%	4.23 E+06
Pasture	2.57 E+12	14.72%	2.19 E+12
Residential	1.32 E+10	0.00%	1.32 E+10
Urban	4.85 E+10	0.00%	4.85 E+10
Wetlands	2.44 E+10	0.00%	2.44 E+10
Failing Septic Systems	1.47 E+09	0.00%	1.47 E+09
Cattle in the Stream	2.55 E+11	26.98%	1.86 E+11
Total Existing Load	**3.07 E+12**	**Load Allocation**	**2.43 E+12**
Total Load Reduction = 20.66%		**Wasteload Allocation**	**0**
		Margin of Safety[1]	**1.28 E+11**
		TMDL = Loading Capacity =	**2.55 E+12**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.7.

6.5 MARGIN OF SAFETY

The margin of safety (MOS) is a required part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991):

- Implicitly incorporate the MOS using conservative assumptions to develop allocations or
- Explicitly specify a portion of the total TMDL as the MOS using the remainder for wasteload and load allocations.

The MOS was incorporated both implicitly and explicitly in developing the TMDLs. Assumptions made in simulating failing septic system loads is an example of implicit conservative assumption used in the modeling process).

The simulation of load contributions from failing septic systems assumes that all fecal coliform bacteria discharged by the failing systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after filtration through soil or surface die-off. Additionally, these discharges from failing systems are assumed to be constant throughout the year, while failures may actually occur less frequently.

To provide an explicit margin of safety, the water quality target for the TMDL was established at a geometric mean of 190 counts/100 mL for a 30-day period, which is 5 percent lower than the water quality standard of 200 counts/100 mL.

6.6 RESERVE FOR FUTURE GROWTH/ACTIVITIES

If the watershed's existing load to the watershed was found to be below the target/endpoint, which was the geometric mean water quality standard less the explicit margin of safety (190 counts/100 mL), then a "reserve for future growth/activities" was calculated. The reserve for future growth/activities is the amount of fecal coliform loading that can be contributed to the watershed on top of the existing loading without exceeding the target concentration of 190 counts/100 mL. The reserve for future growth was calculated by increasing the fecal coliform contributions from the most significant source in the watershed until the concentrations reached the target/endpoint.

6.7 SEASONALITY

Seasonality was considered during the TMDL analysis through representation of conditions throughout an entire year. Seasonal differences in coliform levels could be caused by seasonal variations in precipitation and climate or by seasonal differences in activities in the watershed (e.g., land application of agricultural waste, recreational activities, etc.). Seasonality was evaluated using observed water quality and flow data. Water quality samples were collected quarterly at several monitoring stations in the watershed, providing coliform samples during different times of the year. These data do not suggest a distinct seasonal pattern of in-stream coliform levels, primarily becasue they do not provide consistent records of coliform levels during and across seasons and they do not have corresponding flow values. There is an apparent difference in flow volumes over seasons, indicating varying hydrologic as well as water quality conditions across seasons; although the seasonal differences do not consistently appear over the period of record for flow in the watershed. Although the modeling represented seasonal variation, the TMDLs were developed on a 30-day basis.

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Appendix A

Land Use Classification

TABLE A-1. LAND USE CLASSIFICATIONS IN ORIGINAL LAND USE COVERAGES AND THEIR ASSOCIATED TMDL CLASSIFICATION

LAND USE CODE	DESCRIPTION	TMDL CLASSIFICATION
	FLORIDA CLASSIFICATIONS	
8110	AIRPORTS	URBAN
2540	AQUACULTURE	WATER
6110	BAY SWAMPS	WETLANDS
7450	BURNED AREAS	OTHER
1480	CEMETERIES	OPEN LAND
1400	COMMERCIAL AND SERVICES	URBAN
1860	COMMUNITY RECREATIONAL FACILITIES	URBAN
4410	CONIFEROUS PLANTATIONS	FOREST/VEGETATED
1760	CORRECTIONAL	URBAN
2100	CROPLAND AND PASTURELAND	CROPLAND/PASTURE
6210	CYPRESS	WETLANDS
7400	DISTURBED LAND	OTHER
1710	EDUCATIONAL FACILITIES	URBAN
8310	ELECTRICAL POWER FACILITIES	URBAN
8320	ELECTRICAL POWER TRANSMISSION LINES	URBAN
6440	EMERGENT AQUATIC VEGETATION	WETLANDS
1600	EXTRACTIVE	OTHER
2300	FEEDING OPERATIONS	PASTURE
4430	FOREST REGENERATION AREAS	FOREST/VEGETATED
6410	FRESHWATER MARSHES	WETLANDS
1820	GOLF COURSES	OPEN LAND
1660	HOLDING PONDS	OTHER
1500	INDUSTRIAL	URBAN
6160	INLAND PONDS AND SLOUGHS	WATER
6530	INTERMITTENT PONDS	WATER
1420	JUNK YARDS	URBAN
5200	LAKES	WATER
1740	MEDICAL AND HEALTH CARE	URBAN

LAND USE CODE	DESCRIPTION	TMDL CLASSIFICATION
1730	MILITARY	URBAN
4340	MIXED CONIFEROUS/HARDWOOD	FOREST/VEGETATED
1120	MOBILE HOME UNITS	RESIDENTIAL
1320	MOBILE HOME UNITS, HIGH-DENSITY	RESIDENTIAL
1220	MOBILE HOME UNITS, MEDIUM-DENSITY	RESIDENTIAL
2400	NURSERIES AND VINEYARDS	FOREST/VEGETATED
1640	OIL AND GAS FIELDS	URBAN
8170	OIL, WATER, OR GAS TRANSMISSION LINES	OTHER
1900	OPEN LAND (URBAN)	OPEN LAND
2600	OTHER OPEN LANDS (RURAL)	OPEN LAND
10	OUTSIDE STUDY AREA	OTHER
1850	PARKS AND ZOOS	OPEN LAND
1800	RECREATIONAL	URBAN
1720	RELIGIOUS	URBAN
5300	RESERVOIRS	WATER
1300	RESIDENTIAL, HIGH-DENSITY	RESIDENTIAL
1100	RESIDENTIAL, LOW-DENSITY	RESIDENTIAL
1200	RESIDENTIAL, MEDIUM-DENSITY	RESIDENTIAL
7500	RIVERINE SANDBARS	OTHER
8140	ROADS AND HIGHWAYS	URBAN
1620	SAND AND GRAVEL PITS	OTHER
7200	SAND OTHER THAN BEACHES	OTHER
3200	SHRUB AND BRUSHLAND	FOREST/VEGETATED
5100	STREAMS AND WATERWAYS	WATER
1610	STRIP MINES	OTHER
1450	TOURIST SERVICES	URBAN
8210	TRANSMISSIONS TOWERS	URBAN
8100	TRANSPORTATION	URBAN
2200	TREE CROPS	FOREST/VEGETATED
4100	UPLAND CONIFEROUS FORESTS	FOREST/VEGETATED
4200	UPLAND HARDWOOD FORESTS	FOREST/VEGETATED

Land Use Code	Description	TMDL Classification
6400	Vegetated Non-Forested Wetlands	Wetlands
6200	Wetland Coniferous Forests	Wetlands
6300	Wetland Forested Mixed	Wetlands
6100	Wetland Hardwood Forest	Wetlands
6900	Wetland Scrub Shrub	Wetlands

Table A-2. Land use distribution within the watersheds of the 303(d)-listed segments

Land use	Alligator Creek (acres)	Bruce Creek (acres)	Camp Branch (acres)
Aquaculture	0	0	0
Cemeteries	51	18	0
Commercial and Services	416	318	256
Communications	0	3	0
Communications Facilities	0	0	0
Community Recreational Facilities	15	0	100
Coniferous Plantations	8,485	12,817	504
Cropland and Pastureland	27,559	4,682	1,045
Cultural and Entertainment	0	0	0
Cypress	233	4	31
Disturbed Land	21	10	0
Educational facilities	79	7	95
Electrical Power Facilities	1	3	2
Electrical Power Transmission Lines	119	150	10
Emergent Aquatic Vegetation	21	3	5
Extractive	44	58	2
Feeding Operations	74	47	26
Forest Regeneration Areas	2,826	3,430	710
Freshwater Marshes	188	37	19

Land use	Alligator Creek (acres)	Bruce Creek (acres)	Camp Branch (acres)
Golf Courses	0	0	0
Gum Swamps	0	3	0
Holding ponds	0	0	0
Industrial	20	74	14
Institutional	0	6	0
Intermittent Ponds	6	3	3
Junk Yards	9	57	0
Lakes	3	53	0
Medical and Health care	21	5	0
Military	0	36	0
Mixed Coniferous/Hardwood	5,650	15,695	536
Mobile home units	4	0	0
Mobile home units, high density	0	0	12
Mobile home units, medium density	0	3	3
Nurseries and Vineyards	5	2	8
Oil, Water, or Gas Transmission Lin	0	0	0
Open Land (Urban)	34	8	0
Other Recreational	0	0	0
Outside Study Area	0	0	0
Parks and Zoos	5	9	0
Recreational	0	0	0
Religious	50	23	2
Reservoirs	359	480	37
Residential, high density	1,137	442	286
Residential, low density	1,791	1,091	89
Residential, medium density	573	479	124
Riverine Sandbars	2	6	0
Roads and Highways	47	299	53

LAND USE	ALLIGATOR CREEK (ACRES)	BRUCE CREEK (ACRES)	CAMP BRANCH (ACRES)
SAND AND GRAVEL PITS	0	31	0
SAND OTHER THAN BEACHES	0	0	0
SEWAGE TREATMENT	4	256	0
SHRUB AND BRUSHLAND	974	2,540	84
SLOUGH WATERS	0	0	0
SOLID WASTE DISPOSAL	55	0	0
SPECIALTY FARMS	0	28	0
STREAM AND LAKE SWAMPS	0	409	0
STREAMS AND WATERWAYS	0	1	1
STRIP MINES	22	89	0
TRANSMISSIONS TOWERS	2	0	0
TREE CROPS	126	39	0
UPLAND CONIFEROUS FORESTS	3,236	6,988	280
UPLAND HARDWOOD FORESTS	0	11	40
WATER SUPPLY PLANTS	0	0	0
WETLAND CONIFEROUS FORESTS	45	0	4
WETLAND FORESTED MIXED	6,553	3,323	487
WETLAND HARDWOOD FOREST	401	26	31
WETLAND SCRUB SHRUB	225	201	24
TOTAL	**61,491**	**54,302**	**4,927**

Appendix B

Water Quality Data

The following table presents the actual data used in evaluating the water quality conditions in the Choctawhatchee River watershed.

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
32020029	Bruce Creek N Arm	2/16/82	600
		6/15/83	2100
		7/13/83	170
		7/27/83	290
		4/19/88	3900
		9/5/90	2400
32020020	Bruce Cr Hwy 81 N of Red Bay	12/2/90	100
		6/2/91	160
		12/1/91	80
		6/7/92	50
		12/5/92	50
		6/6/93	30
		8/15/93	20
		11/21/93	50
		2/20/94	80
		5/8/94	10
		8/21/94	1700
		11/20/94	135
		2/19/95	220
		5/21/95	80
		8/20/95	30
		11/19/95	80
		2/18/96	130
		5/19/96	170
		8/25/96	200
		11/24/96	60
		2/23/97	1900
		5/13/97	20

32020012	Camp Branch at Hwy 90	8/15/93	40
		11/21/93	130
		2/20/94	170
		5/8/94	140
		8/21/94	400
		11/20/94	1200
		2/19/95	640
		5/21/95	500
		8/20/95	370
		11/19/95	100
		2/18/96	50
		5/19/96	90
		8/25/96	240
		11/24/96	80
		2/23/97	40
		5/13/97	20
32020014	Alligator Cr Hwy 90 West of Chipley	5/24/84	40000
		12/8/87	11000
		8/15/93	10
		11/21/93	160
		2/20/94	60
		5/8/94	120
		8/21/94	400
		11/20/94	40
		2/19/95	1875
		5/21/95	200
		8/20/95	70
		11/19/95	70
		2/18/96	260
		5/19/96	60
		8/25/96	40
		11/24/96	60
		2/23/97	200
		5/13/97	20
303713086035601	Bruce Creek below Panther Creek	12/15/92	1
		12/15/92	80
		3/15/93	122
		6/23/93	94
		8/18/93	172

303730085563301	Bruce Creek at C.R. 81	12/9/92	98
		3/10/93	28
		6/16/93	110
		8/12/93	42
		3/14/95	28
		6/13/95	24
		8/15/95	110
		10/16/95	50

Appendix C

Cattle and Septic Loading Rates used in TMDL Development for the Choctawhatchee River Watershed

Table C-1. Failing septic system fecal coliform loading rates used in TMDL development for the Choctawhatchee River watershed

Subwatershed	Fecal Coliform Rate (counts/hr)	Septic Flow (cfs)
Alligator 1	5710531.97	5.61E-04
Alligator 2	1815031.83	1.78E-04
Alligator 4	474703.44	4.67E-05
Alligator 5	910109.19	8.94E-05
Alligator 6	3272251.89	3.22E-04
Alligator 7	1168002.03	1.15E-04
Alligator 8	1215683.45	1.19E-04
Alligator 9	1355692.50	1.33E-04
Alligator 10	1745456.66	1.72E-04
Alligator 11	3128474.28	3.07E-04
Alligator 12	1551992.41	1.53E-04
Alligator 13	2296036.08	2.26E-04
Alligator 14	474703.44	4.67E-05
Alligator 15	4652814.65	4.57E-04
Alligator 16	2942632.07	2.89E-04
Alligator 17	939455.20	9.23E-05
Alligator 18	1229234.90	1.21E-04
Bruce 1	84071.75	8.26E-06
Bruce 2	120298.87	1.18E-05
Bruce 3	238227.20	2.34E-05
Bruce 4	358707.57	3.53E-05
Bruce 5	141368.41	1.39E-05
Bruce 6	90355.13	8.88E-06
Bruce 7	214235.86	2.11E-05
Bruce 8	376663.15	3.70E-05
Bruce 9	8507.51	8.36E-07
Bruce 10	222033.78	2.18E-05
Bruce 11	176367.09	1.73E-05
Bruce 12	21373.62	2.10E-06
Bruce 13	260506.17	2.56E-05
Camp 1	471917.08	4.64E-05
Camp 2	1333733.90	1.31E-04
Camp 3	661939.88	6.51E-05
Camp 4	146326.84	1.44E-05
Camp 5	437882.34	4.30E-05
Camp 6	46845.07	4.60E-06
Camp 7	1445906.53	1.42E-04
Camp 8	132886.65	1.31E-05
Camp 9	221132.36	2.17E-05
Camp 10	127886.35	1.26E-05
Camp 11	142651.01	1.40E-05
Camp 12	269.59	2.65E-08
Camp 13	282027.91	2.77E-05
Fish 1	763008.42	7.50E-05
Fish 2	342370.77	3.36E-05
Fish 3	586124.42	5.76E-05
Fish 4	314922.66	3.10E-05

Table C-2. In-stream cattle fecal coliform loading rates used in TMDL development for the Choctawhatchee River watershed

Subwatershed	Load of Fecal Coliform (counts/hr)	Flow (cfs)
Alligator 1	1057026220.14	3.10E-06
Alligator 2	554436298.22	1.63E-06
Alligator 4	219788797.98	6.44E-07
Alligator 5	350384681.94	1.03E-06
Alligator 6	1207164643.53	3.54E-06
Alligator 7	294124331.88	8.62E-07
Alligator 8	468941783.92	1.37E-06
Alligator 9	292407392.54	8.57E-07
Alligator 10	609009817.77	1.79E-06
Alligator 11	297874546.31	8.73E-07
Alligator 12	122591715.00	3.59E-07
Alligator 13	805341740.12	2.36E-06
Alligator 14	220059822.04	6.45E-07
Alligator 15	800967916.13	2.35E-06
Alligator 16	376793375.08	1.10E-06
Alligator 17	167754726.63	4.92E-07
Alligator 18	549571117.74	1.61E-06
Bruce 1	18814255.85	5.52E-08
Bruce 2	100092453.67	2.93E-07
Bruce 3	304910307.70	8.94E-07
Bruce 4	213020819.72	6.25E-07
Bruce 5	4955457.19	1.45E-08
Bruce 6	27889444.08	8.18E-08
Bruce 7	85971322.83	2.52E-07
Bruce 8	169244645.79	4.96E-07
Bruce 9	0.00	0.00E+00
Bruce 10	364925912.85	1.07E-06
Bruce 11	43323165.65	1.27E-07
Bruce 12	20043683.69	5.88E-08
Bruce 13	28993401.12	8.50E-08
Camp 1	9838424.13	2.88E-08
Camp 2	274106134.52	8.04E-07
Camp 3	142861688.88	4.19E-07
Camp 4	61368843.06	1.80E-07
Camp 5	90016199.31	2.64E-07
Camp 6	9110506.99	2.67E-08
Camp 7	173159494.15	5.08E-07
Camp 8	6989949.37	2.05E-08
Camp 9	21140041.37	6.20E-08
Camp 10	12090807.50	3.55E-08
Camp 11	3604852.25	1.06E-08
Camp 12	0.00	0.00E+00
Camp 13	40054647.17	1.17E-07
Fish 1	188250101.52	5.52E-07
Fish 2	67970867.10	1.99E-07
Fish 3	26969420.45	7.91E-08

Fish 4	65616617.37	1.92E-07